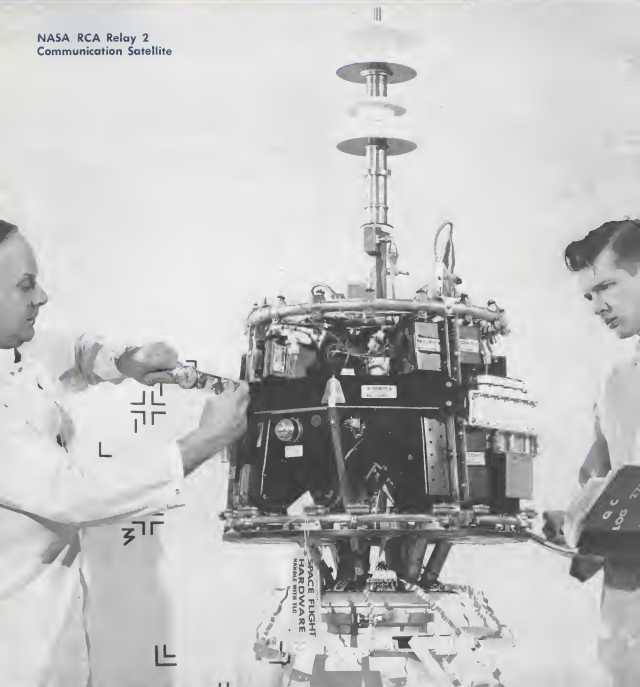


# Aviation Week & Space Technology

December 9, 1963

**Relay 2 Changes  
Designed to Give  
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NASA RCA Relay 2  
Communication Satellite









Time Sharing

## Co-op Computers?

As computers become more common in large organizations, the question arises as to whether one large computer or a number of smaller ones should be obtained. For many applications, it is desirable to make the computer available to the individual user, engineer, or manager. Monthly, economy of operations dictates that the large computers are used in a centralized facility where they are available to the potential user. Then, many applications are spread out processing several small computers to service them. A potential answer to this dilemma lies in the time-sharing approach, wherein computer programs are an arranged that several individual users may have simultaneous access to the computer. Substantiated even hours can be saved by online checking of new computer programs, and service demands become feasible when users are in direct communication with the computer. SDC is developing such a time sharing system within the Command Systems Department, and a large computer,

the AN/SPQ-37, is currently in operation in a time-sharing mode at SDC. The technology of time sharing is but one of many aspects of tomorrow's advanced systems now under scrutiny by SDC scientists and engineers. The time-sharing aspect of systems technology will create a wide range of currently attractive problems at SDC. Human Factors scientists, systems research scientists, systems-oriented engineers, and computer programmers interested in joining a rapidly expanding technology are invited to write Mr. A. M. Giamello, SDC, 2402 Colomado Ave., Brent, Monica, California 90205 who operates in SDC Facilities State Marketing, Washington, D.C.; Lexington, Massachusetts; and Dayton Ohio. An equal opportunity employer.

System Development Corporation



## AEROSPACE CALENDAR

(Continued from page 5)

- aerotics and Astronautics Institute for Mathematical Statistics, U. S. Naval Post Graduate School
- Jan. 27-30-20th Annual Aerospace Conference, Society of Photon Engineers, Chul Shin Hall, Heli North, Atlanta City
- Jan. 27-30-Applied Forces on Airframe Research, University of Illinois, Material Research Center, Urbana, Ill.
- Jan. 28-30-40th Annual Meeting, American Meteorological Society, University of California, Los Angeles, Calif.
- Jan. 29-31-30th Propulsion Rocket Conference, American Institute of Aeronautics and Astronautics, Palo Alto, Calif.
- Feb. 1-7-4th Annual Lecture in Aerospace Medicine, USAF School of Aerospace Medicine, Brooks AFB, Tex.
- Feb. 5-7-4th Winter Convention on Military Electronics, Institute of Electrical and Electronic Engineers, Anaheim, Calif.
- Feb. 14-15-Gordon Gas March, Conference American Society for Metals, Fairmont Hotel, San Francisco, Calif.
- Feb. 19-25-International Solid State Circuits Conference, Institute of Electrical and Electronic Engineers, American Institute of Physics, University of Pennsylvania, Philadelphia, Pa.
- Mar. 1-6-14th Conference on Applied Meteorology (Atmospheric Problems of Aerospace Vehicle), Atlanta City, N. J. Symposium, American Meteorological Society, Federal Aviation Agency
- Mar. 14-Symposium on Tactical Battle of Solid, San Francisco, Calif. Sponsors: National Bureau of Standards, National Aeronautics and Space Administration, USAF, Aeronautical Systems Div., University of California at Berkeley
- Mar. 14-20-Aerodynamic Testing Conference, Morgan Vice-Rodger Moore Hotel, Washington, D.C. Sponsors: American Institute of Aeronautics and Astronautics, TI & N
- Mar. 19-21-International Convention, Institute of Electrical and Electronic Engineers, Columbia and New York Halls, New York, N. Y.
- Mar. 21-27-Aerospaceloc Bearing Conference (continued), El Torero Hotel, San Antonio, Tex. Sponsors: USAF, Southwest Research Institute
- Apr. 12-14th Symposium on Engineering Aspects of Microelectronics, Institute of Electrical and Electronic Engineers, Manufacturers Institute of Technology, Cambridge, Mass.
- Apr. 15-17th Annual Symposium and Materials Conference, American Institute of Aeronautics and Astronautics, Kansas State Univ., Lansing, Kans.
- Apr. 18-19th International Conference on Numerical Methods (Intenag), Institute of Electrical and Electronic Engineers, Shoshua Hotel, Williams, D. C.
- Apr. 19-21-Third International Flight Test Instrumentation Symposium, College of Aeronautics, Cranfield, England
- Apr. 19-23-International Conference & Exhibit on Aerospace Plasma Technology, Institute of Electrical and Electronic Engineers, Westview Hotel, Phoenix
- Apr. 30-32-First General Space Congress, (Continued on page 6)



## Snap-acting thermal switches: Five grams that work like a ton

Whenever you look, you'll find thermal switches, reacting to temperature changes and controlling electrical power. Common switches - in your car, refrigerator, and home heating system. Snap-acting switches - like United Control's 580 series - sense acting thermal switches for safety, control, monitor and alarm.

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**SPERRY**  
DIVISION OF  
SPERRY RAND  
CORPORATION

## AEROSPACE CALENDAR

(Continued from page 7)

March 10n. Costa Beach, Fla. Sponsor: Command Council of Technical Societies. Apr. 11-12—Spring Joint Computer Conference. American Association of Information Processing Societies. Sheraton Park Hotel, Washington, D.C.

Apr. 12-14—Radioelectronics Conference & Electronic Show. Institute of Electrical and Electronic Engineers (IEEE) National Convention, Dallas, Texas.

Apr. 14-May 1—1964 General Air Show. Hancock Airport, Kansas, West Georgia.

Apr. 27-30—Air Transport and Space Meeting and Production Forum. Generalized Hotel, New York, N.Y. Sponsors: Society of Automotive Engineers, American Society of Mechanical Engineers.

Apr. 29-May 1—National Astronautics and Space Administration's Annual Conference on the Possible Use of Space Facilities. May 4-6—1964 National Aerospace Instrumentation Symposium. Sheraton Hotel, New York, N.Y.

May 4-6—Aerospace Propulsion Meeting. American Institute of Aeronautics and Astronautics, Cleveland, Ohio.

May 4-7—American Astronautical Society's 16th Annual Meeting. "Technical Program on Lunar Photo Program." New York Hilton Hotel, New York, N.Y.

May 5-6—1964 National Symposium on High-Speed Electronics. Institute of Electrical and Electronic Engineers, San Diego, Calif.

May 13-15—16th Annual National Aerospace Electronics Conference (NAECON). Institute of Electrical and Electronic Engineers, Boston Hotel, Boston, Ohio.

May 13-14—1964 Annual Scientific Meeting. Aerospace Medical Association, American Hotel, Miami Beach, Fla.

May 13-15—1964 Annual National Forces Spectrum Workshop Society, Sheraton Park Hotel, Washington, D.C.

May 15-21—1964 Annual National Conference. Society of Automotive Weight Engineers, Sheraton Dallas Hotel, Dallas.

May 19-21—International Symposium on Microwave Theory and Techniques. Joint role of Electrical and Electronic Engineers, Maxwell Avenue, N.Y.

May 20-21—General Aviation Design & Operations Meeting. American Institute of Aeronautics and Astronautics, Wichita.

May 20-23—Second International Forum for Air Corps. Sheraton Hotel, Rome, Italy. Montecatini, Canada. Sponsors: Society of Automotive Engineers, American Society of Astronautics and Astronautics, Canadian Association of Space Institute.

May 21-26—Teletype/Computer Air Show & International Airport Equipment Exhibition, Galtville Airport, Turin, Italy.

June 2-4—National Teletype/Computer Conference. American Institute of Electrical and Electronic Engineers/Institute of Electrical and Electronic Engineers/Institute of Electrical and Electronic Engineers/Institute of Electrical and Electronic Engineers, Sheraton Hotel, Los Angeles, Calif.

June 2-4—National Symposium on Global Communications (GLOBECOM VII), Institute of Electrical and Electronic Engineers, University of Pennsylvania and Sheraton Hotel, Philadelphia, Pa.



## Keeps missiles from going off half-cocked

You'll never have to start a firing because of this safe/arm device—it's too simple to cause you any trouble! No wires, no power supply, no connections, no cocked springs, and best of all, no susceptibility to EMI. You can lock it, check it, magnetize it, and remagnetize it, and it still won't do a thing until it's ready, when it is ready, the system is "go."

The Model 1009 safe/arm unit functions only from the acceleration profile of the bed which carries it, both during and during from overlie forces. It can be programmed to fire within a half a "g" of a selected value, and within 0.050 seconds of a required firing time. It will initiate a percussion cartridge for ignition, stage separation, or destruct function, or it may be used to operate a switch.

You need provide only about 3 cubic inches of space in the vehicle for the



Typical operating parameters: Arming period 2 seconds at 15 g acceleration, firing in readiness — 0.5 g — 0.5 g.

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**FIRST** to order Boeing 707-373C fan jets

World Airways, complying with the requirements of its MATS contract, was the first to order Boeing 707-373C convertible fan jets, in April, 1962.

**FIRST** passenger non-stop flight, California to Tokyo

In August, 1963, World Airways flew non-stop from California to Japan with 165 passengers and a crew of 11, with an average speed of 550 miles per hour.

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On November 8, 1963, a World Airways fan jet departed California to Southeast Asia with a payload of 90,148 pounds, the largest load ever lifted by a commercial aircraft.

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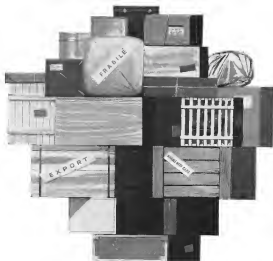
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**TRW** COMPUTER DIVISION

THOMPSON RAND WOODBRIDGE INC.



Despite the tremendous speed and revenues appetite of today's most advanced computers, scientists at Lockheed Missiles & Space Company's Computer Research Laboratories feel that there is room for a great deal of improvement. They have dedicated themselves to the discovery and development of ways to increase the speed and reliability of computers while simplifying their operation.

Though today's computer circuits are capable of operating at speeds measured in tens of nanoseconds, the useful computation rate is far slower. One of the roadblocks hindering speed is the need for the computer to wait for the carryovers from one column of figures to catch up with the main calculations. A possible ex-



planation for this problem is modular arithmetic, which avoids carryover. Based on the ancient Chinese Remainder Theorem, this concept is being re-examined at Lockheed for potential computer applications.

Lockheed's Computer Research Laboratories is a study in a very broad group of related computer research areas, and the company can boast that an unusual number of its specialists are at the very forefront of their specialties.

Among the major areas of research being undertaken at this time are basic physical phenomena, such as phonons; quantum mechanics; switching theory; modular arithmetic (number systems); assembly; threshold logic and pattern recognition and logic design techniques.

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Consider Lockheed's leadership in space technology. Evaluate its accomplishments—such as the Polaris missile, the Apollo-11's superb record of space navigation. Examine its outstanding advantages—location, advancement policies, excellent climate, opportunity for recognition.

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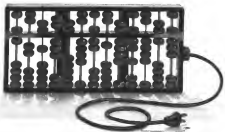
**SCIENTISTS & ENGINEERS** In addition to positions relating to computer research, such as logical design specialists and mathematicians, other opportunities exist for specialists in: Thermodynamics • Infrared guidance • Electromagnetic • Orbital thermodynamics • Gas dynamics • Chemical & nuclear propulsion • Systems engineering • Electronic engineering • Communications & optics research.

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*Basic research toward simpler, faster, more reliable computers*



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MERCURY



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GEN III

## AND FLY the SPACECRAFT OF TODAY

As the Research and Technology Division of the Air Force Systems Command (AFSC), and the World-Spanning Center of the National Aeronautics and Space Administration (NASA and NAS),

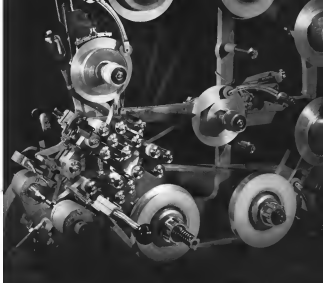
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Why this "electronic spinning wheel"?

It makes capacitors for our multiplex and microwave systems.

We make our own because the frequency selective filters in which the capacitors are used are required by our own standards to do duty for 25 to 30 years, without breakdown or any significant departure from their original values.

This is a tall order for a manufacturer of quality communications equipment, but is essential to video, voice and data transmission systems where a slight change in a filter can drastically degrade the frequency response of a long distance circuit.

In making the capacitors, the machine winds alternate layers of polystyrene and metal filter sand the process capacitance is

checked. The operation is performed in a dust-free room, under rigid temperature and humidity control. The capacitors are then sealed into moistureproof capsules.

Finally, no capacitor ever becomes a part of a Lenkurt filter about first being subjected to several severe voltage breakdown tests.

By "trusting our own" precision capacitors, you are assured of engineering excellence in Lenkurt multiplex and microwave equipment. It's one more reason why it pays to talk to Lenkurt first when you're planning a video, voice or data transmission system. Lenkurt Electric Co., Inc., San Carlos, California.

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## Centaur's Success

A significant milestone in the development of space technology was passed on Nov. 27 with the successful orbital flight test of the Centaur liquid hydrogen-powered space vehicle. The significance of the first successful Centaur flight for the future of space exploration lies in two broad areas:

• **Technology.** The second great propulsive step beyond the liquid oxygen and kerosene technology that began the space age depends on the use of liquid hydrogen fuel in the upper stages of space vehicles that can reach the moons and probe the planets. The technical feasibility of using liquid hydrogen as propellant for a space vehicle was amply demonstrated by the perfect performance of Centaur's two RL10A-3 rocket engines through a 380-sec. burning period. Solutions to the engine problems that once seemed to make liquid hydrogen as impractical fuel have been paved as the Centaur flight. Although there is still much work to be done to achieve the sensitive reliability for hydrogen-powered vehicles that manned space flight requires in the upper stages of Saturn, it is evident that this fuel is well handled on the road toward technical success.

• **Management.** The Centaur success also taught significant lessons in the management of development programs pushing new technical frontiers. Persistence in honoring goals despite some agonizing fluctuations in management policies and personnel paid off for Centaur and liquid hydrogen technology. Further tests might have canceled the program under this stress. It also demonstrated how proper management and organizational can reduce apparently insurmountable barriers to solvable problems.

## Centaur's Key Men

It has been a long and rough road from the original upper stage studies by General Dynamics/Astronautics in 1956-57 to the orbiting Centaur of 1965. As in any effort that produces significant technical progress, its success was dependent on the flair of the men who participated in the program, from the early ideas conceived by Knott Elrick to the successful flight last month from Cape Canaveral. At San Diego, it was Grant Hansen, a vice president of General Dynamics/Astronautics, who was given the job of organizing the team that pulled the Centaur vehicle through its toughest development problems. At Palm Beach, it was Bill Gorton, general manager of Pratt & Whitney Aircraft's Florida Div., and his two chief engineering lieutenants, Bruce Tordell and Dick Malinski, who brought the RL10A-3 engine to its current reliability as the pioneer in liquid hydrogen fueled rockets.

At Cleveland, it was a Lewis Research Center team

headed by David S. Galbraith, Centaur project manager, with Edmund Jernick, Gary Nettles and Ronald Rowinger who developed and executed the rigorous ground testing program in the wind tunnels and rigs that paid off as well as the ascent flight performance. And at Capitol Hill, it was Rep. Joseph Kephau (D-Minn.) whose investigation into Centaur's troubles shook the program out of its management difficulties and established its priority as a vital step in the lunar landing program. The investigation conducted by Rep. Kephau's subcommittee of the House Science and Astronautics Committee is a prime example of how a responsible congressional investigation can contribute constructively to the solution of major national problems.

Many times during the Centaur's fluctuating career under successive management of Advanced Research Projects Agency, Air Force and two different NASA centers, the technically timid would fear the abandonment of liquid hydrogen because its problems appeared too difficult to reach the promised goal of a 40% increase in propulsive efficiency. Many times the professional conservatism asserted that the program should be abandoned because it would prove to be a great waste of the taxpayers' money with no possibility of any technical progress.

## New Era Dawns

Now that Centaur has opened the way to a new era in significantly larger space payloads, the folly of listening to those faint hearts should be readily apparent. Development of the upper stages of Saturn, all fueled with liquid hydrogen, can proceed with more certainty after Centaur's demonstration. The Centaur vehicle itself will play an important role in the post-Apollo exploration of the moon and planets. It is scheduled to carry a soft landing instrument package onto the moon's surface next year and, in 1967 and 1968, it is to carry Mariner instrumented payloads for close reconnaissance of Venus and Mars.

Centaur's success with liquid hydrogen also has provided badly needed encouragement to proceed with operational development of other exotic rocket propellants such as fluorine for greatly improved performance from existing military missile systems and space launch vehicles.

Centaur should merit a permanent page in the history of the space age as an excellent example of what can be accomplished when industry and government devote their best talents and undragging determination to seek for a distant but desirable technical goal. It has taught lessons that must not be forgotten when new barriers loom on the frontier of technology.

—Robert Blatz



## BFG brakes help T-38 bring home safety record

Despite its use as a trainer, the Northrop T-38 had the lowest major accident rate of any supersonic aircraft in the U.S. A.F. last year. It was the first supersonic plane to complete a full flight test program and enter operational service without a single flying accident.

In the very high number of takeoffs and landings performed by T-38s, reliability is placed on B.F. Goodrich brakes. The disk brake system is comparatively unsophisticated and is highly reliable.

In many of today's high performance aircraft, BFG brakes are proving their capacity for fast, dependable, chatter-free stops. They deliver high torque without fade, and retain them, even during wear.

For the best in aircraft brake performance and brake design experience, choose B.F. Goodrich. For information, contact B.F. Goodrich Aerospace and Defense Products, a division of The B.F. Goodrich Company, Department AM-12, Troy, Ohio.



## one, two, three, kick!

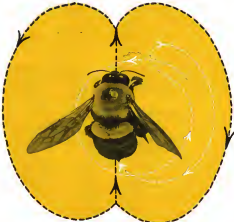
When a foreign bee performs a curious series of dance steps he is "telling" the hive bees on the location of a new food source. Call it programming, perhaps. It is an accurate input of absolute distance and direction that enables the hive bees to pinpoint the target to the meter. There then ensues a "bee line" to the food source by means of a precise navigational system weighing but a fraction of an ounce.

Our solutions are somewhat lighter. Understandably so as our capabilities apply to larger systems. We take an immediate interest in

accurate navigation. We've proven ourselves in sensing and processing inputs to our precise navigational systems, a airborne digital computers, air data computer systems, integrated avionics, displays, isolated ground and in-flight test and checkout equipment. Our future is fully planned to manage complete electronic orientation systems for aerospace, land, marine, and submarine applications. Like the bee, we will know, in any environment, where we are, where we are going, and how to get there.



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## WHO'S WHERE

### In the Front Office

**Lee D. White,** *head chairman, Target Business Information, Inc., Anaheim, Calif.*  
**Alvin R. G. Butler,** *president, Stridley Aircraft Radio Co., Inc., Los Angeles, Calif., a subsidiary of Ryan.*  
**Wesley S. Melillo,** *acting president of System Development Corp., Santa Monica, according to M. D. Kippert, resigned.*

**John B. Montgomery,** *a vice president, Schlumberger Ltd., Houston, Tex., he was named as president of Deere, Inc., a division of Schlumberger.*  
**James O. Wright,** *president, Federal Metal Heat Treating, Inc., Detroit, Mich., according to Guy S. Pappert, now head chairman of Guy Mattern, former chairman, conference as a director.*

**Donald G. McKee,** *now president, American Products Operations of the Lockheed Co., Glendale, Calif., according to M. D. Kippert, resigned.*

**Norman Rudman,** *chief executive officer of Chicago Pneumatic Tool Co., New York, N. Y., according to Guy S. Pappert, who is serving as head chairman and chief executive officer. The post of chairman will now pass, according to M. D. Kippert, resigned.*

**Dr. David E. Smith,** *a vice president, Philco Corp., Newport Beach, Calif., according to Guy S. Pappert, who is serving as head chairman and chief executive officer.*

**George S. Dillon,** *executive vice president and a director, Air Reduction Co., Inc., New York, N. Y., and Joseph H. Handman, chairman, a group vice president. Mr. Dillon will be the chief operating officer.*

**Balfour Beatty Ltd.,** *Durham, England, has announced the following appointments to the production organization of the Aerospace Division: W. J. Miller, chairman, and J. Wood, general manager (Scottish Group); R. Nicholson, general manager, production; and J. E. B. Parker, chief staff officer (Staff).*

**Robert L. Trent,** *vice president-research and development, National Semiconductor Corp., Sunnyvale, Calif.*

**Charles E. Miller,** *treasurer, The Boeing Co., Seattle, Wash.*

**Heinrich and Elections**

**Donald W. Douglas, Jr.,** *has been elected head chairman of the American Industries Assn., Washington, D. C., J. L. Alford was elected vice chairman and Karl G. Hira, Jr., president. Mr. Douglas is president of Douglas Aircraft Co., St. Louis, Mo., according to Guy S. Pappert, who is serving as head chairman and chief executive officer.*

**Raymond D. Decker,** *president of Electronic Systems Corp., San Francisco, has been elected president of the Western Electronic Manufacturers Assn., Los Angeles, Calif., according to Guy S. Pappert, who is serving as head chairman and chief executive officer.*

**Joseph A. White,** *NASA chief scientist in the X-33 project, has been named 1993 Pilot of the Year by the National Pilot Assn.*

**Ron Rudman,** *vice president of Pacific Aerospace Corp., has been elected president of the Western Distributors and Manufacturers Assn., according to M. D. Kippert, who is serving as head chairman and chief executive officer.*

## INDUSTRY OBSERVER

Weather Bureau is streamlining its process along operations to the Nimbus-2 in the operational communications satellite (AWS Oct. 7, p. 31).

Weather Bureau's fundamental algorithm in Nimbus-2 that operational Nimbus-2 might be overcome by using an onboard ground system instead of hardware, and a ground-based distribution system instead of gas jets.

Version of Boeing-Bellco Blue Star air-to-ground missile has been tested successfully at low level in the Weapons, Aeronautics, and Space (AWS Oct. 7, p. 31). The missile proves out, the Blue Star missile will be equipped with the Blue Star version could be adapted to low-level attack pending introduction of the Boeing Aircraft Corp. TSR-2 air-to-air missile (AWS Nov. 4, p. 31). TSR-2 missile has not been announced, although a nuclear weapon is known to be under development.

Feasibility of injecting an interplanetary monitoring platform (IMP) in a 10,000-mi. circular lunar orbit is under study by National Aeronautics and Space Administration. Imps would be in various orbits, including the influence of the earth's own gravitational field. Since being launched last month, would be used (AWS Dec. 1, p. 23). NASA refers to the project as LIMP, for lunar interplanetary monitoring platform.

Lang-Tanen-Vought will study the application of a smaller version of the chemical low-altitude missile (AWS Dec. 1, p. 34) in the General Dynamics/PL. Worth approach to the advanced ramjet-powered missile (AWS Nov. 11, p. 35). The missile would be called CLAMP, for chemical low-altitude missile, possibly.

Armat General Corp. claims a new, simple method to terminate solid-propellant rocket thrust. Company details are proprietary, but the technique used in these operations, possibly by injecting a liquid or gas into the thrust. Armat says it has demonstrated the system and has suggested rocket burning in microseconds.

First Martin T-28 Orion launch vehicle is scheduled to undergo its success compatibility firing test within two weeks, and its flight readiness test next month. Launch is scheduled for February.

Army Missile Command is expected to extend the feasibility study phase of the Army air defense missile for the 1970s (AADS-70) by about 45 days to include consideration of rocket-fuel and technical development plans based on funding levels of \$5 million, \$10 million and \$15 million. At the end of the extension period, two of the three study contractors—Hughes-Douglas, Rockwell-Martin and RCA-Bellco—will be selected to conduct the program definition phase, expected to be completed by the end of next June.

Department of Defense Research and Engineering (DOD&E) is considering whether responsibility for system management of the "Wingspan" Clouds air-to-ground missile will be given to the Naval Ordnance Test Center or to a joint contractor. If the test center gets the job, it will select industry for several subsystems, such as data link, propulsion and possibly the airframe. There is a possibility that an air-to-air weapon may be included in Clouds improvements.

NASA has finally abandoned the Lang-Tanen-Vought Scout vehicle as the launcher for the 500-pb. micropropulsion. The probe had been made for the micropropulsion, and now will be launched from the Pacific Missile Range, and in a Douglas D-15. New inspection is now being prepared for the change in orbital inclination.

Program of USAF Ballistic System Dr.-a clock-airframe range ballistic missile program, now designated 125-A, can be closed again because to DOD&E from that certain aspects of its specific operational requirement pose the state of the art and may cause development problems. Ballistic System Dr. tech that changes would impact the effectiveness of the system.

For Force is expected to provide about \$250 million for the substantial orbital necessary to extend the operational usefulness of the Boeing B-52 bomber to the 1975-1979 period (AWS Dec. 1, p. 23).



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## Washington Roundup

### Cape Kennedy Debate

Florida is growing restless as protesting President Johnson's abrupt Thanksgiving Day action of changing the name of Cape Canaveral to Cape Kennedy. The nearby communities of Cape Canaveral and Cocoa already are asking their city attorneys to find a way to avoid the President's action, and the Florida congressional delegation expects a big volume of protest mail.

Sen. Spessard L. Holland of Florida asked President Johnson the day before his name-change announcement to deliberate the matter longer. But the President went ahead anyway. He said he had consulted beforehand with Florida Gov. Farris Bryant, who has just sworn affirmed his support for the change. But the legal issue for the action is fuzzy.

Those of the critics to Florida lawmakers is that it would be fitting to call the combined Air Force missile test center area and the space agency's Merritt Island launch area the John F. Kennedy Space Center. But the residents opposed that changing the name of the Cape mall amounts to converting history. Spanish maps 400 years old bear the name Cape Canaveral.

A resident of Satellite Beach wrote Florida Sen. George A. Southerland that President Johnson's action was "high handed." Several other letters suggested changing the name of Cape Cod to Cape Kennedy instead. An Orlando woman wrote "Cape Canaveral does not have to be named after a national hero. It is a national hero."

Other recent actions under consideration include changing the name of New York International Airport to the John F. Kennedy International Airport, and calling the USAF Space Services Div. complex at Langford and El Segundo, Calif., Goddard AFB after Tihon Charney, the late Air Force assistant secretary. Air Force Systems Command last July concluded that the area could not be called an Air Force base because there was no runway. But now the command is reconsidering, with a decision expected soon.

### Incentive Contracting

Protagonists of the President Johnson's economy demands (see p. 20) will boost their campaign to write more incentive-type and bonus cost-plus-fee contracts. They also are happy about the latest action on that effort.

George C. Beaumont, Defense Dept.'s deputy assistant procurement secretary, said cost-plus-fee contracts dropped to a new low of 12% of all Defense Dept.'s contracts in Oct. 50. This compares with the high of 35% in March, 1961.

Army Materiel Command has established a project manager office called Fast Support. Aerial Systems for its aerial helicopter program scheduled to start next year. The helicopter would not replace the Bell UH-1. The aerial helicopter will be the first Army aircraft to go through a program definition phase and be subjected to the PERV-Cost System.

### Time-Saving Thwarted

Air Force effort to use time in negotiating development contracts has run into a legal obstacle. U. S. competitor general said this month that even preliminary negotiations cannot be started until after the Air Force receives his certified that this type of contract, rather than a cost-plus-fee one, is justified.

Until the new ruling came out, Air Force Systems Command was beginning negotiations with contractors after determining that a negotiated contract was necessary. They saved the 30 days or more it usually takes for the secretary to make his own finding.

Chairman Mike Mansfield of the Senate aviation subcommittee considers the financing of the supersonic transport is its biggest problem, but sees no chance of President Johnson changing the government's policy. 75-25% development cost sharing formula—supplies because he originated it while Vice President.

"I see it," Sen. Norcross told the Radio Free America Commission for Americanism last week, that the proposed 75-25% government-industry formula "will have the continuing endorsement of both our executive and legislative branches of government."

He said the 75-25% government-industry formula for sharing flight test expenses "may be the Air Force's best of the plan because no one knows what it will cost to develop the supersonic plane. . . . This is one of the things we will have to look at soon carefully."

### Ringside Seat

U. S. is learning a lot about Russia's latest launch vehicles at the sophisticated tracking facilities at Johnston, Midway, Kwajalein, Bora, and aboard ships and submarines focus on the current scene of Soviet rocket tests in the Pacific (see p. 27). Some time ago a U. S. submarine almost managed to retrieve a Soviet nose cone.

National Aeronautics and Space Administration budget cutters, encouraged by technical problems, have their eyes on the Mariner Mars flyby and capsule launch missions slated for 1966. NASA may reduce the scope of the missions to task orders. . . . With the Air Force in select selected observation its Project Forward attack, soon, showing the future needs of the nation. . . . McChesney's F-15 in development will not be used in the next year. . . . That's a little chance the House will follow Senate by passing the bill to require the Civil Aeronautics Board to fix international air transportation rates.

—Washington Staff

# Closer DOD, Space Fund Scrutiny Seen

Congress prepares for detailed Fiscal 1965 budget review, will hold Johnson to his economy pledge.

By George C. Wilson

Washington—Congress is preparing for a detailed examination next year of President Johnson's broad promise to economize as much as possible on national defense and space programs.

Several House committees have been laying the groundwork this session for the most detailed review so far of the defense and space budgets. And the Senate, though not as far along, is moving to equip itself for handling those money requests in a more expert fashion.

The review coincides with the first letter President Johnson sent to the defense construction department, "It is my desire that you establish an effective program of cost reduction in the procurement of defense equipment, both those which you now build and those which you may subsequently receive."

"It sounded the same economy theme in his first presidential address to Congress Nov. 1" (AW Dec. 3, p. 18). "I pledge that the expenditures your government will be allocated with the utmost thrift and frugality," he said. "I will assure that the government gets a dollar's value for a dollar spent."

## Legislative Groups

Developments in these legislative groups indicate that the legislation will peak behind that session and begin to trickle in at that session for Fiscal 1965 defense and space budgets next year.

House Armed Services Committee Chairman Melvin Price (D-Ill.) of the newly created committee and defense subcommittee is slated to launch his review of the Fiscal 1964 military research budget this week. Rep. Price and that committee have conducted its most arduous for several months, but gives his subcommittee the education it needs to analyze properly the Fiscal 1965 military research budget.

He said his subcommittee will start its analysis at issue in the Defense Dept. Fiscal 1965 budget presented to Congress. This will be the first time that the full committee—which sits ceilings on how much can be appropriated—will have the services of a special research subcommittee. "There is no doubt as you read," Rep. Price said, "that careful scrutiny can eliminate some of the cost."

The House Judiciary, who is a leading proponent of civilian propulsion for aircraft and ships, and the time has come "for a general tightening up" in research and development spending. He said a recent speech he made on this theme struck such a responsive chord in the nation that he received more com-

munications 12 various than work on

general research problems, the committee plans to determine what specific areas should be considered. "It's obvious," says Rep. Elliott said, "that we can't look at every project and cut it out with the business of evaluating research results. Instead, he said, the committee must find a way to maintain costs, overlapping and the way possible for research are established so it can make some policy suggestions for the government's. It's still in the mind of research effort. The House directed the committee to look at work by next December, then making 1964 the crucial year for accomplishing its mission.

House Science Committee Chairman George P. Miller (D-Calif.) is expected to follow the general committee's lead to follow the information committee the National Aeronautics and Space Administration's Fiscal 1965 budget is due. In addition, the panel committee will study the research and development subcommittee plans to make recommendations in this budget area.

## Staff Work

Charmen Emilio G. Dallara (D-Calif.) of the House Science Committee staff work will continue. Several new and when the NASA budget hearings start. Also, he hopes to have a special committee representing industry and universities established by then to advise on research projects.

Rep. Dallara said, the subcommittee hearings have shown the need for "better scientific" before development and scientific achievement. He said the subcommittee hopes to get further guidance by holding field hearings in California cities in Massachusetts and California.

House Science Committee staff work will put to answer research costs to passing the defense and space budget requests is part of the impetus for the committee of the Senate. Sen. E. L. Bartlett (D-Mass.) and 14 cosponsors are pressing for passage of a bill to establish a Congressional Office of Science and Technology to provide expert guidance on federal research programs in both the House and Senate.

The director of the House and Senate research units, Sen. Bartlett said last week in explaining his bill to the House Administration Committee, "shall be scientific possibilities—men who are active in a general way of all that is happening across the entire industrial spectrum of science research. They should be people who know what the specialists are. For they will not themselves undertake direct programs in specific issues."

They will advise on the progress of the men in the field who have already

ready thought deeply about the scientific issues which come before the Congress.

Sen. Bartlett said the office director would get individual members in contact in touch with respected and independent scientists who could give constructive research projects.

"Further, he said, the office should lead, while costs are making decisions today, which right and by law should be made by the Congress," Sen. Bartlett said. "These decisions dealing with the location of our scientific and technical resources must be made. Whether the Congress chooses to make them or not does not alter the fact that they must be made. If Congress does not make them, someone else will. Congress will make them and does not allow someone else to make them. This, too, is a decision in national decisions about the allocation of these resources."

The scientific basis for the high cost—costs demand the decision—designs which representative government must recognize and provide for. He said these decisions "should be made by an informed legislature which understands the costs and the benefits of the program."

Because Sen. Bartlett's bill will be lumped with other proposals for improving Senate procedures, there is no chance the scientific office will be established as a time to help review the Fiscal 1965 Defense Dept. and NASA budgets. But the governing support by his bill cannot help but good chairman of Senate committees that now have this new committee. Meanwhile, the committee will take a closer look at these spending requests.

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# Soviets Plan New Rocket Tests

Soviet Union has announced that a new series of rocket tests will be conducted in the Pacific Ocean during the period between Dec. 2 and Jan. 15.

A Moscow newspaper said "superpowered rockets of cosmic objectives" would be fired into two areas east-northeast of Johnston Island and south of Hawaii and the other northwest of Midway Island.

The tests are planned to last for about 10 days, from Dec. 15 and 15 AW Mar. 15, 1965, allowing only a few moments of latitude or longitude. The May tests included the launch of two Soviet unmanned satellites, Cosmos 17 and 18, on May 22 and 24.

Probe rocket tests were conducted by Russia in January and July, 1963 September and October, 1964, and October and November, 1965. The report says one 1,000 and 7,000 m. from launch satellites out of the Cosmos line.

Personnel measurements of rocket tests stated that the vehicles would be only stage error noted, implying that they could be used either in nuclear defense studies or in space launches. The most recent announcement specified the rockets were for space purposes.

As news of the announcement, the Russian press for the first time reported the failure of a component during a rocket test launch. The Red Army newspaper Red Star said that a spring intended to act as a plug from the side of the rocket, probably attached to the unlaunched object, failed to complete its job. The rocket began using its own power, which if it failed too long, would affect the guidance system.

As news of the test from the printed control area, pulled the plug and returned with only 6 sec. before launch. Launch was successful, the paper said. A new, stronger spring was designed and another rocket added to the unlaunched system, it said.

argue that it is now safe to reduce military spending even further.

However, President Johnson and Defense Secretary Robert S. McNamara will contend next year that the Defense Dept. budget has already been cut as much as possible. President Johnson in his Dec. 1 letter to 7,500 defense contractors said he had directed all government agencies "to accelerate any methods they think to operate their programs at the lowest possible cost. The secretary of defense has already established a cost reduction program aimed at achieving annual savings of \$4 billion through claims new programs to be launched by Fiscal 1967, and he has further committed his department to achieving \$15 billion of these savings in the current fiscal year.

I have said the creation of defense to the military and the administration of contractors who increasingly reduce the cost of defense procurement while making future space weapons, and in determining policy and for more on non-military and military contractors."

McNamara, in an accompanying letter to the contractors, urged them to conduct value engineering programs to effect savings. He also recommended better control of a competitive bid.

"In the future, possible reduction" to use money and "to stimulate the full play of the free enterprise system." He said contractors should be free to price and substitute types "whenever possible." He also urged them to make use of automation programs to increase productivity, strong budgetary controls to reduce both direct and overhead costs, simplification of procedures, and elimination of unnecessary activities. . . . I urge that

you give to these and other cost reduction ideas which I know will save you cost in our national peace and defense.

Spokesman for the Aerospace Industries Assn. and National Security Industries Assn. and their members responses would recognize wholeheartedly in the Administration's campaign drive.

Programs efforts and the economy program in the President and McNamara were not expected to avoid the cost-cutting program in the Fiscal 1965 defense budget, which is just about completed. However, the economy drive may be the balance against some marginal projects, they said.

# Espionage Pilot School

Advances AFR, Calif.—An advanced version of National Aeronautics and Space Administration's M-2 lifting body (AW Sept. 4, p. 18) will be employed by the Aerospace Research Program Office here for a training device. Various studies conducted would be powered by a turbojet engine for ground and air launch.

Col. Charles E. (Chuck) Yeager, commander of the school, flew the M-2 in the first evaluation flight in a series planned by the school before developing any possible maneuver of from three to five M-2 type vehicles. Yeager was flown to a 4,000 ft. altitude by a C-47 and then released. He glided the vehicle in a landing on the lake bed at a 4,000 ft. descent rate.

M-2 program for the school has not yet received official sanction.

# Opposition to Joint Lunar Offer Repeated

By Donald K. Pate

Washington—President Johnson last week reaffirmed the U. S. offer made by late President Kennedy to conduct a joint manned lunar landing program with the Soviet Union, despite continued congressional opposition to a joint effort.

Indebted congressmen who objected to the original plan rejected those objections after the proposal was renewed. Last week, a joint House-Senate conference committee was ready to report an amendment to National Aeronautics and Space Administration's Fiscal Year 1964 appropriations bill prohibiting NASA from spending money on a joint program without the consent of Congress—action opposed by President Kennedy's administration.

Reaffirmation of President Kennedy's proposal came earlier last week in a policy statement by United Nations Undersecretary Adolfo Sotomayor to the UN Committee on the External Data of Outer Space. Sotomayor and President Johnson had exchanged views to review President Kennedy's offer.

"There are areas of work—short of penetrating the two national political systems—how, which all could benefit," Sotomayor said.

President Kennedy's proposal, made in September before the UN General Assembly, called for a joint effort over the jointly of the Apollo program, and prompted congressional criticism of NASA's budget (AFS Sept. 5, p. 20). Critics said that if the U. S. is not to be left in the lurch with Russia, a NASA budget of over \$5 billion for the next 1970 program is not justified. The House showed its disapproval with the proposal by adopting an amendment prohibiting NASA from

spending any of its appropriation for "jointworking in a manner here looking to be carried out jointly by the U. S. and any Communist, Communist-influenced or Communist-dominated country."

The Senate softened this slightly by rejecting an appropriation measure which prohibits NASA from participating in a joint program without congressional consent.

House members were prepared to accept the Senate version Dec. 5, setting the stage for final passage of the NASA appropriations. Both houses earlier approved a NASA appropriation of \$5.5 billion for Fiscal 1964, and funding was not at issue in the conference.

In the past, congressional approval of NASA's program has been limited to budget authorizations, and the space agency has been free to adopt international agreements without congressional consent. The amendment indicates a growing demand in Congress for a voice in NASA's international approach.

Sotomayor said international cooperation has played a significant part in the U. S. manned space program and that the policy of engaging in mutually beneficial and mutually supporting cooperation in outer space with the Soviet Union is with all nations—does not begin or end with a manned lunar landing.

Among which the Administration is interested in cooperating with the Soviet Union on establishing an international tracking network, sharing biomedical data and collaboration gathered on the consequences of the lunar environment, and establishing a joint lunar base. Sotomayor said exploration of the moon is not a short-term task; it is the only chance of seeing of only two nations.

Members of congressional space committees are split on the extent to which the U. S. should enter into international programs.

Sen. Gordon Anderson (D-N.M.), Senate committee chairman, has announced that the U. S. should pursue an international program in manned as well as unmanned space programs. Sen. Anderson said he did not oppose a joint U. S.-Soviet program and has pointed out in the past that he supported such a program in a Senate speech.

Rep. Otto Teague (D-Tex.), chairman of the House manned space subcommittee, said America's first manned lunar mission should be a joint U. S.-Soviet venture. He said that he did not think we would get anything in return. He added that further risk of a joint program makes it financially difficult for NASA to get the funding it needs to keep the lunar program on schedule.

## Foreign Nations Weigh Joining Comsat Group

Rome—Political-technical talks now underway in Rome between the United States and the North American NBX-70 have been completed next week with the assistance of the USAF Flight Test Center's telemetry and communications relay network based at Woomera, Australia, providing a 500-mi. transmission channel. The NBX-70, however, is not expected here before March.

A central team, complete with a glass-and-plastic and test-time data recorder display, has been completed and checked out during NBX-70 flights. During the Chicago NBX-70 tests, the experiment was supervised by North American engineers who also will act as ground control authority. Up to 15 parameters will be monitored via the relay network telemetry network during the NBX-70 tests, including orbital surface movement and certain engine temperatures. Position and altitude of the aircraft will be plotted continuously.

The Westerners' mission will add to the Flight Test Center's longer straightaway, so that high speed test flights may be conducted with the added safety of ground control authority who can shut the relay network down.

Active participants in the Rome conference were Austria, Belgium, Czechoslovakia, France, Germany, Greece, Ireland, Italy, Monaco, Norway, The Netherlands, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

## Hindustan to Build Alouette 3, Engine

Gurgaon-Hindustan Aircraft, Ltd., will build an indigenous number of 200 Alouette 3 turbopropellers and 200 Alouette 3 engines for the Indian Air Force.

Terms of the initial contract awarded by the Indian Government call for a total investment of \$19 million in tooling, primarily for the engine. The amount for actual construction of helicopters will be fixed later.

The licensing agreement, which has been under consideration since the Hindustan Aircraft Ltd. was set up (AFS Sept. 17, p. 46), provides for full technical assistance including specifications, drawings, test facilities and maintenance manuals for fabrication and flight of the helicopters. All technical documentation will be in English according to India. Indian engine and propeller engineers are being sent to France. Hindustan and Sidel will conduct technical studies in Bangalore. Production is scheduled to begin in the second half of 1964. India's Sidel will produce the engine, which will be assembled in India. India will be required to adapt tests to the Indian environment—particularly high-altitude operation in the mountainous northern regions that were the scene of last year's fighting. It is demonstrated in the Indian Hindustan, an Alouette 3 loaded and took off at about 10,000 ft carrying a maximum crew and 100 lb of payload. India has been assembling the French-built Alouette 3 for about one year.

The Alouette 3B is a 4-rotor helicopter capable developing 550 hp with a 750-hp rate between overhead (AFS Aug. 5, p. 46). Indian, specialized methods and all engines and outputs for the engine will be obtained from Turbomeca. The French engine is being used in the Alouette 3B, because it has been producing such low losses in the Rotax-Helicopter Engines 700 and 701 and Rotax-Helicopter Ltd. R.D. 2 under license.

## Edwards Extends Data Network For High-Speed Aircraft Testing

By C. M. Fletcher

Edwards AFB, Calif.—Paul Gustafson, flight test director, has announced that the North American NBX-70 test will be completed next week with the assistance of the USAF Flight Test Center's telemetry and communications relay network based at Woomera, Australia, providing a 500-mi. transmission channel. The NBX-70, however, is not expected here before March.

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The Westerners' mission will add to the Flight Test Center's longer straightaway, so that high speed test flights may be conducted with the added safety of ground control authority who can shut the relay network down.

In addition to the NBX-70, the Com Dynamics/Comsat P-111 (TPC) and the North American 2 X 13,

now being modified as a Mach 6 test aircraft, will use the larger range facilities. The 450-mi. range from Edwards AFB to Woomera, Australia, data can be gathered has been adequate up to now for NBX-70 test flights and other Flight Test Center testing, such as that as the NBX-70, completed last month.

An additional planned relay system is in the pipeline. The USAF Flight Test Center will extend the Flight Test Center to the Pacific Missile Range. The connection, which would take about 15 miles, is complete, would provide at least a 1,000-mi. transmission channel for high-speed testing, providing an air test range at relatively high altitude. It also would provide the Flight Test Center with an ocean water test area, which it does not now have.

Planning for the major range link was started during the 1954-55 fiscal year, but the Flight Test Center has again asked for funds in the Fiscal 1965 budget requests. If money is appropriated, the Flight Test Center probably will use an existing relay system at the Pacific Missile Range. The system is being used by the Navy's Naval Air Station, which is conducting the building block approach in which direct and component-networks are assembled application-by-application being developed in parallel, suitable parts of which are being developed.

existing conventional telephone equipment, USAF cost analysis show. USAF is reluctant to estimate the amount of savings because of its intention to avoid a side-scan radar, but the estimate could be as low as the projected \$100 million.

As the designated receiver after the NBX-70, Edwards will be responsible for control during the testing phase after receiving control from the Atlantic Missile Range. The final handoff will be from the FMB tracking network.

The NBX-70 test flights scheduled to begin next October will be conducted in the local Edwards test area, and will not require the use of the extended range facilities in connection with the NBX-70 mission. Flight Test Center needs a relay system for projects Oct. 14 for high speed test flights in the Pacific Missile Range. It is estimated that the cost of the relay system is approximately \$100 million.

Total cost of the data acquisition and transmission network, also known as the relay system, which the Westerners' mission, has been estimated at \$1.5 million. This included \$500,000 for maintenance performed under an on-call-type contract. The data acquisition and transmission system is being developed for approximately 14 years and has been used extensively by National Aeronautics and Space Administration's Flight Research Center in X-15 testing.

Milestones begin work on the system 14 years ago and will complete the current extension in Dec. 15. The network, including the Woomera extension, is scheduled to be completed by 1970 and serve numerous other tests. The network relay units are located between the data acquisition sites and receive the required signals to the test site.

The unattended sites are located on favorable high terrain to maximize the number required. The range is approximately 110 mi. wide on either side of a line connecting the sites, for an average 100-mi. width.

## Research Emphasis

New York—Space Research is well underway although one focus has reached the point where more data can be obtained to give answers. Deputy Defense Secretary Russell L. Galt, Jr., announced last week that the Defense Dept. spends on per month in universities and private laboratories will be increased over the 1960 level.

The agency now plans to do this. It is also planning to build a relay system to give the Defense Dept. a building block approach in which direct and component-networks are assembled application-by-application being developed in parallel, suitable parts of which are being developed.





## West Germany to Concentrate on STOLs

West-German Defense Ministry is turning over from June VJOL combat aircraft and says it will concentrate exclusively upon STOL vehicles because of the latter type's in-demand, efficient and light support requirements. Under this concept, the current two series of Messerschmitt Henschel Bolkow VL300C interceptor prototypes will be turned to completion, although program will not result in production orders.

Double it is the need for VL111 type aircraft in late 1950s or early 1960s replacement for Lockheed F104Cs have been expected to sell over a year. There are strong indications that the project would be terminated after flight test program is completed sometime late next year (AW Oct. 5, 1962, p. 19, Oct. 18, p. 7). The reason behind the decision to withhold the VL111 from production, aside from resource situations at STOL aircraft, thus possible from changing operational requirements rather than technical difficulties, Defense Ministry says. Lt. Gen. Werner Fuchs, chief of the West German Air Force, has, for example, doubted the inclusion of armed interceptors when warning threat of air force attack would be marginal at best (AW Feb. 5, p. 12).

However, there has been no less decision on whether to keep armed aircraft around at least one of roles now assigned to the F104C, including reconnaissance and interdiction, when that aircraft phase out of the air force inventory. Plans are continuing for 1950-60 replacement of the Fiat G91 strike fighter with same form of STOL aircraft, and development of the Focke Wulf 130D a contender. An issue planner, however, kept that they eventually can adjust its aircraft developed and purchased by Soviet nations as a G91 successor.

The VL10C test program is being continued to use all possible technological effort which could be incorporated into a future VJOL prototype.

Plans for next year include light form of the experimental X-2 prototype with three thrusts attached to the aircraft's Bolkow RB145 engine.

drogs and slugs 2,000 lb of liquid oxygen recovered in AC-2's tanks in residual propellant at burnout of the stage. Through pressure and vacuum tank system located on the offsetting tankage, NASA engineers hope to get some idea of the behavior of oxygen propellant under prolonged atmospheric and their ballast rates when exposed to direct solar radiation.

Hydraulic data of fluid particles in particular, since the S-48 fluid stage of the Saturn 5 launch vehicle will be the stage which will propel the manned Apollo spacecraft to the moon. It also uses liquid hydrogen and may have its cost in orbit with orbit for several hours for transfer to a planetary trajectory.

These liquids were expected to give

and vent through relief valves when pressure exceeded predetermined levels. Resection of the stage to venting was expected to cause Contractor to handle ground observers may be able to see the stage, and in dark, at night, the glaze of the hydrogen tanks. NASA believes that the stage will appear at a second or third-order of magnitude and, because of the handling, will seem to twinkle.

AC-2 had four accelerators and 14 second-stage objectives (AW Nov. 11, p. 41). Three of the primary goals—demonstration of the combined Atlas Centaur vehicle's structural integrity, demonstration of the new stage separation system and evaluation of the RL-10A-3 engine's performance through a full 500-sec burning time—were successfully accomplished by 17 min after lift-off.

The fourth major goal—validation of the Minneapolis-Honeywell inertial guidance system, which was down company—was a continuing task. One source says that the gyro-stabilized platform remained extremely stable during previous flight. It also appeared to be operating until once the stage was in orbit.

Telemetry data indicated that all important events in the AC-2 flight took place occurred close to predetermined figures and that all systems operated satisfactorily. A few isolated measurements were lost, but program officials believe that the information could be recovered through redundant systems and compensation from other measurements.

A source with a 10 hr lifetime, at-

tached to the stage, was tracked air-to-air by NASA's deep space stations at Goldstone, Calif., Johannesburg, South Africa, and Woomera, Australia.

Contract contractors generally are optimistic about the potential of liquid fuelage added to the liquid oxygen stage, as first reported by Aviation Week & Space Technology (Apr. 15, p. 23).

They say that feasibility programs now under way at General Dynamics, San Diego, Calif., Pratt & Whitney, West Palm Beach, Fla., and Rocketdyne Div. of North American Aviation, Canoga Park, Calif., are progressing well. They believe that an Atlas Centaur vehicle, with about 1375 lb thrust in the booster stages of both booster and upper stage, could provide the Service spacecraft with an additional 200-300 lb to be loaded on the moon.

NASA is reported in growth version of Service between 3,500 and 3,000 lb, and the Air Force in Atlas ICBVs which could cause heavier version which has longer duration. The addition of fuelage, it is believed, could then give additional NASA is considering the use of Atlas boosters originally built for the now terminated Mercury program as vehicles for the accelerated propellant conclusions.

## Pressurized Grand Commander Planned

When development program is a pressurized version of the Grand Commander is under way by Aero Commander Div. of Rockwell-Standard Corp. First deliveries to customers are planned in mid-1964.

The Grand Commander lineage is being tested in a water tank by the company. The program will be similar to that on the Model 600 Commander, which is available in both pressurized and unpressurized version, with about a \$50,000 price difference.

The Grand Commander pressurized version is expected to be similar to that used on the Model 600P, providing a cabin differential of 1 psi, holding sea-level pressure to approximately 9,000 ft, and providing an equivalent of 6,000 ft altitude when the aircraft is at 17,000 ft.

Aero Commander has verified benefits of an ocean-the-board price increase as all piston-engine Commander averaging 5-10%, in line with labor and material cost increases.

New prices, with previous prices in parentheses, are: Model 1000, \$94,900 (\$87,000), 600P, \$115,500 (\$105,000), 600P, \$115,500 (\$121,000), 600P, \$115,500 (\$116,000), Grand Commander, \$116,000 (\$116,000).

Price of the Jet Commander is being held at \$578,000.



HAWK GOODPASTER SUBROC autonomous mobile ocean worker worked in depth charge bins. Classified underwater through torpedo tube, before, proved by first-stage ship depth charge bins, to be in use to reduce drag and save cost measures gains.

## Operational Test Phase Nears for Subroc

By Michael L. Yaffe

New York—Navy last week took the wraps off its newest air-sea warfare weapon, the robot-powered Subroc autonomous depth charge.

Under development for the past few years, the underwater mobile recently completed a major test program in the Pacific demonstrating its operational feasibility (AW Nov. 20, p. 21). The Subroc program will enter its operational evaluation phase next year in a package to combat some of the weapon system's operational problems.

Controlled and developed by the Naval Ordnance Laboratory, the mobile carries a nuclear warhead in the form of a depth charge. It is currently designed to kill a submerged enemy submarine, but could destroy a surface

ship "many miles away" (Unofficial estimates peg the weapon's maximum range at 60-75 mi.)

Although an underwater to under water missile, Subroc travels most of the distance to its target through the air to minimize susceptibility to drag and target time.

The Navy is holding 25 minutes per second, 754-day attack rehearsal in the water under Subroc's. The first of these, the USS Thresher, was lost in an accident only this year. A later ship, the USS Permit, is now carrying the mobile and has performed most of the underwater testing of the vehicle covered to date. In all, it is believed that there are now five 994-class submarines in operation.

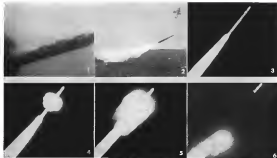
As presently situated, total cost of the Subroc weapon system program is

expected to run to approximately \$300 million. Condor Aerospace Corp. and the mobile subcontractor are funded for \$150 million of this. There is a possibility, however, that the weapons system will be put on existing IBM Polaris-class nuclear submarines. The Navy says that it has also investigated the use of Subroc on surface ships, that it is working on a long-range target system for surface ships, and that surface ships may be used in the near future with a "Subroc-type" weapon system. It is also conceivable that the Subroc weapon system could be put on Navy submarines, according to the Navy.

The 994-class attack submarines, which run 279 ft long and displace 1,770 tons, are designed around an advanced AN/DDQ-2 acoustic detection



BLW-OFF COVER on aft end of Subroc first stage OTCs water out of the low thrust water control enables and flow is sufficient to maintain desired pressure to blow the cover. Aft end of the stage is in use to reduce drag and save cost measures gains. Close-up (right) shows first and second stages of the mobile being sent out toward of the third seventh port.



**SABROC LAUNCHES** Sequence shows (1) missile being hydraulically ejected from the torpedo tube. At a safe distance from the submarine, the rocket motor ignites and pushes the missile out of the water (2) and into the air (3). At a predetermined point, the three forward pods spin up (4) providing stabilization prior to ejection of the forward pod of the first-stage motor. Forward thrust builds up (5), slowing down the first stage motor and permitting the improved, mid-course-thrust stage (6) to fly on to its target.

system. Heart of the AN/BOQ-2 system is Raytheon Co.'s AN/BOQ-1 console, which can detect enemy submarines at long range.

In addition to Sabrocs, the attack submarine can carry long range hunting and mine guided torpedoes. The passive torpedoes are carried by an attack submarine will depend upon its mission. Sabrocs can be armed like torpedoes, or the submarine's own forward-firing torpedo tubes with backup missiles directed inside the sub.

Data from the submarine's AN/BOQ-2 console comes as from data sources and periscopes feed into the Mk 115 underwater fire control system developed by General Precision, Inc.'s Livermore Div. With the data and a forecast from the submarine's Shipboard Navigation System, the Mk 115's complex of analog and digital computers can track several targets and provide firing and control orders for both Sabrocs missiles and torpedoes carried in the attack submarine. This ability to handle multiple targets and weapons, simultaneously—or in rapid succession as far as firing sequence goes—is expected to contribute in important defense against enemy wolfpack attacks.

Cumbar, a subsidiary of Goodson Tool & Rubber Co., designed Sabrocs to be launched horizontally from a rigid submarine torpedo tubes. One of length of the missile is 21 ft. Its weight is approximately 4,000 lb. The first stage rocket motor is 21 in. in diameter

and approximately 11.7 ft long. The Sabroc second stage is about 9.7 ft long and 13 in. in diameter without fins.

The second stage's nose cone is followed by the earliest warhead/depth

#### Anti-Tank Missiles

Feasibility of adapting the Sabrocs and Tor used in submarine launchers, such as the Ball Mk 118 torpedoes, against enemy tanks, armored personnel carriers and other targets is being investigated by Army Missile Command.

Contract for studies of possible feasibility associations with Sabrocs and Tor will be awarded by AMC to Armstrong, Inc. of Peoria and Hughes Aircraft Co. prior studies for the two missiles. Flight demonstrations are not anticipated in these initial studies.

Both weapons are line-of-sight, semi-guided types, so that launch from an offshore platform would give them the equivalent of an "over the hill" capability. This would be particularly valuable in submarine or jungle regions. Sabrocs has a sensitive electronic command guidance, Tor (Fibre-launched, Gyrojet-tracked, Wire-command link guided missile) is wire-guided.

Three weapons in helicopter positionally would be an improvement for the French 58 ft anti-tank weapons.

charge, an adaptation for its sailing and steering the warhead, the guidance section, and the auxiliary power jet which provides the missile's onboard electrical and hydraulic power.

Primary propellers for the missile are provided by a composite solid-propellant rocket motor developed and produced by Thiokol Chemical Corp. and containing numerous pyrotechnic and a polyethylene fuel burner. This latter long identified with polyethylene and hydrocarbon fuel burners, and it is selected the polyethylene because it is selected a combination of high specific impulse and low burning rate. Thiokol uses a polyethylene solid-propellant grain in the propellant system, however.

As a solid-propellant and provides the missile's electrical power needed by the missile from pre-launch to water entry. A hydraulic torque control system (pulses the mechanical power) of the guidance section is taken from this computerized control and Auxiliary Power Supply (APS) system is provided by the Garrett Corp.

Most of the inertial guidance system is inertial sensing of a tri-axial platform and platform electronics manufactured by General Precision's Aerospace Systems Div. The three-gravel platform is stabilized by three forward air-integrating gyros mounted on the inner (usually) gimbals. These three-Sabrocs pre-launch accelerometers, also mounted on the inner gimbals, detect acceleration forces acting on the missile and provide platform leveling

information before launch of the missile to orient the gyro data, this is how the Sabrocs weapons system operates.

Once a target is acquired, range and bearing data from a range in right sensor start feeding into the Mk 115 calculator for control system. The system rapidly determines the latest position of the target, accounts for the target in relation to its own ship and the anticipated human position. It then compares and refers commands to the Sabrocs—through three available command actions in the aft end nose platform to order weapons, reaching them for launching. It provides graphic displays of target data, graphical attack situation, weapon status and status in location. The actual firing order is issued by the submarine commander, and this is the last control input to the missile from the submarine.

Water is pushed out of the torpedo tube hydraulically, using water, is the same manner as a conventional torpedo. There are three torpedo tubes staked vertically on each side of the bow, designed to fire the weapon at an angle of 15 deg. away from the bow. Although the fire control system is set up to handle a number of weapons simultaneously, there is approximately a 10 sec. delay between weapon firings to avoid interference problems.

Once fire of the torpedo tube, the weapon bow on the top aft end of the Sabrocs fire off and a dual delay switch provides a positive 1 sec. delay before arming. At the bow end of the first stage, the pyrotechnic fuse that is activated into the sub-assembly device opens a soft, low pressure flame down the length of the rocket motor, igniting the solid grain engine.

With the missile in a safe distance from the launching submarine, pressure from ejection of the missile motor near the bath holding the forward nose that keeps water out of the rocket motor.

Activates on each of the four rocket motors are actuated by signals from the guidance system carried by cables running through an interface between the propellant grain and nose cone. They provide direct on-axis control of the missile in both the vertical motor and air portions of its flight path.

Sabrocs moves out of the water, propelled by its rocket motor. At a predetermined point in the missile's trajectory—selected by the fire control system before the missile leaves the torpedo tube—a signal from the missile guidance system fires the explosive bolts in the yoke holding the first and second stages. A second signal from the guidance section causes explosive bolts in the sub-assembly device at the forward end of the sub-assembly device to fire forward, allowing combustion gases from the rocket motor to rush forward



**SABROC SECOND STAGE** Control of quality and amount of water are determined in test apparatus at Goodson Aerospace Corp. plant in Akron, Ohio. Gyrojet plate on the left end helps in the forward end of the missile's first stage.

into the plenum chamber in the forward double bellhead.

After the pressure in the plenum chamber reaches a set point, it forces forward blows out all 10 forward-burner thrust reversal plugs on the front end of the first stage to avoid sea-ice setting moments that would cause the missile off course. A reverse thrust system matches second-half blows the forward thrust builds up, separating and slowing the first stage rocket motor and ensuring it is hauls to the ocean.

The augmented second stage continues on to the target. Mineable fins are fired on the aft end of the second stage to provide synchronous stability. Centrally pivoted fins behind the fin fins are controlled by signals from the missile's guidance system. Then the second stage, firing the pressure and angle of the gyroscope as it enters the water. Moved by hydrostatic pressure from the main APS unit, the gyroscope is blown off the missile just before re-entry.

A shock absorbing nose cone which breaks apart upon re-entry absorbs most of the 1,200 ft/sec impact. The propellant then acts to explode at a predetermined pressure.

#### Industry View Asked On R&D Cost Shifts

Washington—Defense Dept. has asked major industrial contractors to comment by Dec. 15 on proposed amendments to the present Armed Services Procurement Regulations that define three independent research and development costs that could be paid by the federal government under a contract.

Changes in section 15 of the regulations state that costs can be allocated to a government contract if they are incurred specifically for the contract, in part if they benefit both the contract and other work, or if they are shown to be necessary to the overall operation of a business, including the contract work.

Costs of gathering bids would not include independent research and development performed.

Existing language in the regulations is not considered clear enough for contracting officers to make clear-cut decisions in cost apportionment, or to conduct standards established by the Budget Bureau.

# Vast Impact Seen in DOD Spending Shift

By Katherine Johnson

Washington-Major reduction in defense spending consistent with the national interest would present "both a tremendous opportunity and also a yet unsolved problem of major proportions," according to a comprehensive report submitted to the Senate by the Stanford Research Institute.

The report was presented to the Senate manpower subcommittee, which concluded hearings last week on the impact of defense spending on the national economy, by Morris L. Woldenhouse, senior economist with the Institute.

The report was a challenge to previous Defense Dept. testimony to the subcommittee, headed by Sen. Joseph E. Clark (D, N.J.), that the defense industry would be able to absorb a 50 percent reduction in defense spending without any adverse effect on the economy. Clark had earlier said to the subcommittee that all but a very small "hard core"—amounting to only 1% of the gross national product—of the \$10 billion-a-year defense program could be readily converted to civilian uses (AW Nov. 11, p. 10).

"There is no reason that the economic impact of defense programs—whether decreasing from major budget shifts either up or down, or from the shifting pattern of procurement within a relatively steady budget—cannot be accommodated without serious dislocation or deprivation of our overall economic position," Colquhoun said.

## Miniature Laser

Miniature laser beam gas laser, which emits pulsed infrared radiation at wavelength of 4.33 microns, and operates continuously at room temperatures from direct current, has been demonstrated by Bell Telephone Laboratories.

The laser discharge tube is only 2 cm long and less than 4 mm in diameter, and several tenths of an inch long and less than 1 mm in diameter. The laser beam is emitted from a small discharge tube, and the laser beam is emitted from a small discharge tube.

The miniature laser emits light with a wavelength of 4.33 microns, and operates continuously at room temperatures from direct current, has been demonstrated by Bell Telephone Laboratories.

The Stanford report indicated a monumental adjustment problem from any significant shift in either the amount or the pattern of defense spending. It would center on firms engaged almost wholly in defense work in their industries: aerospace, shipbuilding, and electronics. The problems would be compounded, the report said, by the fact that these firms are concentrated and account for over one-third of the total manufacturing employment in seven states: Kansas, Washington, California, New Mexico, Connecticut, Arizona, and Utah.

The areas from which would be most sensitive to a reduction in the defense budget were given as Republic Aviation Corp., McDonnell Aircraft Corp., General Aircraft Engineering Corp., Lockheed Aircraft Corp., Aero Corp., North American Aviation, and Hughes Aircraft Corp. In the other report, these companies have defense sales accounting for from 100% to 75% of their total business.

By comparison, the report noted that although the oil industry, with the aerospace and shipbuilding industries as a second defense supplier, its defense sales account for only 10% of total output and a reduction in defense business would result in only marginal adjustment problems.

Discontinued companies already engaged in aerospace work and having the 50 top defense contractors, the report also noted would withstand the impact of a substantial reduction in the defense budget with comparative ease. These examples were included:

- **General Electric Co.** About \$1 billion a year in military space sales represents only 20% of GE's total sales. Its aerospace sales are about 51% of Lockheed's total sales; \$1.2 billion is about 75% of North American's total sales; \$1.2 billion is about 64% of the total sales of General Dynamics Corp. and \$1.1 billion is about 65% of the total sales of The Boeing Co.

- **American Telephone & Telegraph Co.** total of \$475 million a year in government aerospace business is only 4% of AT&T's total business, while \$484 mil-

lion a year is about 68% of the total business of Douglas Aircraft Co.

- **General Motors Corp.** Over \$450 million a year in military-space business is only 5% of GM's total. Compared with this, \$100 million a year is 97% of McDonnell's total business.

Two solutions were proposed:

- For the short term, converting conversion to commercial or civilian government business by "diverting from large amounts of non-defense research and development contracts in non-defense goods which these companies would produce and sell to the government."

"Also," the report said, "under existing military contracts, the Dept. of Defense could do several things which would currently require the government's capability of defense contractors, such as testing commercial product planning in an allowable rate. This would provide a financial inducement to defense contractors to perform total commercial market while still engaged in defense work."

Because military production contracts are difficult to convert to commercial markets, the report said, "it may be questionable public policy to accept very large amounts of government funds in converting" that conversion.

For the long term, shift highlights toward defense research and development, the report said, "the government could have tremendous long-term benefits for the country, and aerospace research industries," the report said. To encourage commercial companies to a second defense supplier, the report proposed: for jobs for increased research expenditures, government aid, after the pattern of the existing aerospace program of the Defense Dept., under which the government pays the costs but is reimbursed if the research leads to profitable production, and government loans or loss guarantees for research projects.

## Escape Test Scaled

Dragageo space shuttle using two ballistic charges to speed up the escape test, the report said, has been successfully tested by Douglas Aircraft Co.'s Lang Beach, Calif., Div.

The company's test vehicle, called Escape 2, is a rocket-propelled test vehicle and a dummy payload from a state twice to a 200-ft altitude. One charge sent the escape to the full length of the shock test and the second opened it in a sec. The parachute deployed at 150 ft and the dummy hit the ground undamaged.



## Jet-Augmented Helicopter Begins Research Program

Kennedy Aircraft Corp. has begun the YJ95 helicopter with jet thrust augmentation provided by a General Electric YJ95 engine in a pod installation on the side of the aircraft. The engine produces 1,500 hp, of thrust without afterburners. The helicopter was modified under a contract from Army Transportation Research Command and will be used to investigate high-speed flight characteristics of the rotor system. Research may be step toward a high-speed compound aircraft, combining fixed-wing and helicopter characteristics.

## Douglas Has NASA Station Study

Washington-Douglas Aircraft Co. recently has been awarded the contract to study National Aeronautics and Space Administration space station design in a concept that is expected to be accepted over that of Air Force's space station.

Air Force begins studies the next few weeks to develop their concepts for Earth-orbiting station of its own space station concept. Late next month, NASA and Air Force contractor studies probably will be completed, with the two agencies, and a single set of specifications written for a permanent deep space complex.

The Douglas award first reported by Aviation Week & Space Technology (AW Nov. 16, p. 11) came after three months of study by the company, Douglas and Boeing. At the time three contracts were awarded last June, NASA said it would select one of the two for a preliminary design (AW June 21, p. 10).

Since then, however, NASA and Defense Dept. have come closer to fundamental ideas of what a manned space research station should be and the Douglas study will be a refinement rather than a preliminary design.

Air Force requested 45 contractors to bid on its space station studies (AW Oct. 25, p. 20).

A total of 25 contractors turned in proposals to the Air Force.

Both Defense Dept. and Air Force say they are anxious to avoid three parallel study bids before the end of this year.

The Douglas study is being managed by Langley Research Center's Mission

Orbital Laboratory Study Office, directed by William N. Gardner. The Douglas contract consists of a general technical study to be completed by a Series III vehicle.

Original concept was for launch to be made by a Saturn I.

Douglas also will study use of Titan 2 or Titan 3 to launch both free and target vehicles to the station. Originally, Titan 2 was to launch Gemini free vehicles and Titan 3 was to launch target vehicles.

A space station is generally considered to be the next major manned space flight program. Both Defense Dept. and NASA agree that space station program will satisfy both needs. Yet it is not clear which agency will manage the station program.

## News Digest

Congress has authorized \$179 million in supplemental money for Atomic Energy Commission to increase support of the role of the nuclear test facility. The funds cover construction of 12 new design support development laboratories and facilities. BNL has been sent to the White House for the President's signature.

Radii Corp. of American's RCA Service Co., Camden, N. J., has been selected by the National Aeronautics and Space Administration to operate the "Columbia" communications system for the agency's Mariner Mars Launch Area, Fla. The contract, of the cost

photoelectric for tape, is expected to amount to about \$5 million over its three-year period.

Research award for the Interplanetary Navigation Platform (INP), launched Nov. 26 from Cape Canaveral (AW Dec. 2, p. 34), reported by NASA was \$122,800 and project 118 was with a period of 4 1/2 days.

NASA-Hughes Systems 3 communications satellite will be launched next spring into a stationary, synchronous geosynchronous orbit by a three-stage Douglas Thoron vehicle. Standard Thoron, used to launch previous Hughes payloads, has sufficient thrust to achieve stationary synchronous orbits.

NASA and the Australian government last week announced conclusion of testing facilities at Murrumbidgee to Canberra, as the first major part of Australia (p. 66). The new station will be used to track observations, signals and Gamma and Apollo manned spacecraft.

Experimental communications satellite ground station will be built in Eastern Canada by RCA Victor Co., Ltd., of Montreal, under a \$5-million contract from the Canadian government. The facility, expected to be operational by the fall of 1965, will use in 85% of its antenna will be designed for use with both medium altitude and low altitude satellites.

Dr. Gen. George H. Butt, USAF, (ret.) is a military aviation pioneer and deputy commander of the Allied Forces in the Southwest Pacific in World War I, died Dec. 2 in Orlando, Fla. He was 77.

# Pan Am, BOAC Reach Fare Compromise

Flexible formula sets stage for general North Atlantic agreement; IATA group considers plan at Nassau.

By L. L. Doty

Washington—Pan American World Airways and British Overseas Airways Corp. have compromised on a rate formula that is expected to bring about general agreement on a fare structure for North Atlantic operations.

The formula will be presented to an International Air Transport Association working group, consisting of airline representatives at the vice presidential level, which was to begin a meeting Dec. 9 at Nassau, Bahamas. The 19 airlines serving the North Atlantic market have been authorized by the passenger line since following the collapse of two IATA traffic conferences at Salzburg, Austria (AW Nov. 16, p. 18).

These are the basic details of the Pan Am-BOAC proposal:

- **Fair-charge fare.** New York-London, would be set at \$400 one way and \$750 round trip. The current will continue to rise on a one-half cent basis, but it is necessary to obtain general agreement. This proposal is apparently aimed at satisfying Trans-Canada Air Lines, whose vigorous stand for sharp rate reductions was directly responsible for failure of the first Salzburg conference in Pan Am.
- **Two economy fares would be introduced.** \$200 one way and \$390 round trip, and \$325 one way and \$540 round trip. The higher fare would apply only to off-peak travel for the 10-week period following the last week in May, and an off-peak travel for the 10 weeks after the last week in October. The lower fare would apply to all other fares. The plan is a modification of the proposed threshold fare presented to the first Salzburg conference in Pan Am.
- **An executive fare of \$500 round trip, good for 23 days between Mar. 1 and Oct. 30, has been proposed.** The fare would not apply for travel on Friday-Saturday or Sunday-Sunday, and for travel periods, such as the popular last-bound period in late June and early July.

The controversial group fare which El Al and Lufthansa strongly advocate may never prevent rate-making agreement. This American and BOAC will argue that the group fares are no longer necessary in view of the low executive fares, and will propose increasing the executive fare from the present \$110 to \$150, and require a total of 35 passengers for a group rather than the current 25. Such changes are expected to satisfy any rate of the group fare structure.

Meanwhile, a government treaty, headed by Civil Aeronautics Board Chairman Alan S. Bond, has obtained from a 12-day visit with governments and aviation officials at 10 nations in hopes of bringing about agreement on the fare issue. In addition to Bond, the group consisted of Robert T. Murphy, CAB vice chairman, Allen R. Ferguson, State Dept. coordinator for international aviation, and Alfred R. Hunt, chief of CAB's air line division.

## No Tentative Results

The group reported no tentative results, and that the talks only resulted in "a unanimous desire and recognition that IATA will promptly reach an agreement resulting in a universal fare structure."

Reaction to airline officials here, largely reaction to the visit was positive, and was noted in European aviation circles as an unambiguous position taken by a major government. Ironically, the airlines, however, IATA, have strongly defended their rights to receive differentiation on fares without government interference.

The threat of such interference has

always been present, but it was never applied until the Civilian traffic conference reduced the round-trip discount rate from 10% to 5% which, in effect, brought about a fare increase (AW Oct. 22, 1962, p. 36). That action prompted the CAB to threaten U.S. carriers to agree to increase.

Recommendations from European governments were quick and better and included threats by several European nations to the U.S. aircraft carrying passengers into their own airspace in fear that the IATA standard. A meeting of the governments involved at Ottawa (AW July 23, p. 2) resulted in these demands and reinforced the intent to lower the fares of airlines within the IATA traffic conference.

However, the CAB continued to demand that U.S. airlines and carriers, and sent two observers to the first Salzburg conference. Meanwhile, following the trip to Europe, the second of its kind in the last year, the Board reported that the first IATA members would resolve the fare problem "without government interference."

European carriers meant the CAB action possibly because it has led the public to identify them as high-fare carriers, and that the talks only resulted in more instances. It is expected, however, to recognize that North Atlantic fares might not have been reduced had not the CAB intervened, and that the Civilian government firmly stood for drastic cuts.

## Diverse Opinions

Meanwhile, the IATA, cargo traffic conference, the last week in Nassau, North Atlantic carrier rates. Sealed World Airlines and Pan Am-BOAC entered the conference with widely diverse opinions on how to adjust rates. The CAB is also taking part in a meeting on rate for specific commodities, while National Airlines refused rates for specific commodities at high weight levels and cancellations of certain specific commodity rates.

In this connection, the Board warned that "the cargo rate is not homogeneous," and added:

"It is a composite of tariffs, determined by individual carriers, and is based on a wide variety of factors, such as weight and characteristics. Pricing requires an appropriate balance between carrier costs, value of service, price offered and the traffic received."

## TWA Sues Three-Class Service

New York—Time World Airlines has filed Civil Aeronautics Board appeal of a new American domestic one-stop jet service. The CAB has ruled that TWA would provide three separate services aboard each of its modified Boeing 707-420R.

- **New Standard Class—160-cabin seats priced at \$182 plus 10% tax.** Passengers would receive complimentary snacks and drinks. Liquor would cost extra, but meals would be served at night.
- **First-class class of \$180 plus 10% tax.** Meals would be served at night with wine, with first-class and second-class.
- **Third-class class, reduced from \$140 to \$104, would be available for 15 seats, no-charge.** A complimentary meal and liquor at extra cost would be offered. No service would be offered.

According to the jet, which now may 30 first-class and 19 second-class, would cost \$28,000.

Charles C. McLaughlin, TWA president, said the three-class service, if approved, would be an improvement. It would, he said, TWA might try more experiments.

TWA's move, aimed primarily at businessmen and government personnel, is a response to United Airlines' new three-class service and to the three-class service adopted by Continental Air Lines between Chicago and the West Coast.

## Halaby Goes to Moscow for Aeroflot Talks; SAS Move May Bar Bilateral

Washington—Talks between U.S. and Russia on a bilateral air transport agreement were scheduled this week in Moscow despite a formal Scandinavian policy with the Soviet Union. The move could block such negotiations of New York-Moscow service.

Danish Foreign Minister Jørgen Østergaard said Secretary of State Dean Rusk, that Scandinavian nations will probably Aeroflot issue flying over their territories on the New York-Moscow route. Rusk said that the New York-Moscow route is a bilateral air transport agreement between Moscow and Tokyo. Rusk said that the New York-Moscow route is a bilateral air transport agreement between Moscow and Tokyo. Rusk said that the New York-Moscow route is a bilateral air transport agreement between Moscow and Tokyo.

In the face of this hurdle, Noreg's Eirik, Foreign Minister, said that the New York-Moscow route is a bilateral air transport agreement between Moscow and Tokyo. Rusk said that the New York-Moscow route is a bilateral air transport agreement between Moscow and Tokyo. Rusk said that the New York-Moscow route is a bilateral air transport agreement between Moscow and Tokyo.

The Scandinavian countries, such as the Soviet Union, have refused to accept a bilateral air transport agreement between Moscow and Tokyo. Rusk said that the New York-Moscow route is a bilateral air transport agreement between Moscow and Tokyo. Rusk said that the New York-Moscow route is a bilateral air transport agreement between Moscow and Tokyo.

Last week, Sen. S. Mike Mansfield (D-Mt.) announced reports that pressure in top-level government circles in Washington to speed up the negotiations on a bilateral air transport agreement have been given during the past two weeks. Pan American World Airlines, U.S. carrier that would operate the New York-Moscow route on a temporary basis with Aeroflot, reportedly has been discussing

a commercial bilateral agreement with the Russian state-owned airline.

Rusk last month, President Kennedy had expressed optimism that the agreement would be signed (AW Nov. 4, p. 26) following a review of technical details. These details reportedly have been sent to the State Dept. by FAA with Pan Am, Customs, Guard, and State, Defense, and Commerce Dept. officials. Russian agreement on these points will pave the way for formal signing of an agreement by the two nations.

The Scandinavian air transport agreement with Aeroflot has been scheduled for the New York-Moscow route. Rusk said that the New York-Moscow route is a bilateral air transport agreement between Moscow and Tokyo. Rusk said that the New York-Moscow route is a bilateral air transport agreement between Moscow and Tokyo. Rusk said that the New York-Moscow route is a bilateral air transport agreement between Moscow and Tokyo.

Russia is known to be anxious to get traffic rights between New York to Cuba, but because of its reluctance to leave the New York-Moscow route, this move probably will not be used in the current negotiations.

## Pan Am Board Votes Debenture Issue, Split

New York—Pan Am stockholders, a \$60-million issue of convertible debentures, and a \$100 million issue of convertible debentures, has been approved by directors of Pan American World Airways. The proposal also includes the raising of quarterly dividends from 10 to 15 cents, a 10% increase in the price of stock from \$19. The split,

which must be approved by stockholders at an annual meeting in May, the quarterly dividend will be 15 cents.

The debenture issue, which will be applied for by the company, will be offered for \$100 million on order, and will be available to clear its books of debt. It has \$21,760,000 still outstanding as a \$14,500,000 bank loan received in December, 1961.

"We are going to need more financing in future operating operations, such as the super-jet transports," a Pan Am spokesman said. "That will be the reason we need our books of bank debt."

Payments on Pan Am's existing \$140 million in long-term debt, acquired from operating companies, do not begin until 1965. The company has no plans to call \$45 million in outstanding debentures.

The airline presently has eight Boeing 707-320C cargo planes on order, scheduled for delivery in 1966-67. There have already been deliveries. Two more Boeing 720Bs, delivered for Latin American routes, are also on order. Pan Am's new 15% down payments on each of the aircraft when orders were placed.

Of 10 million common shares presently authorized, 5,340,798 are outstanding. Pan Am's earnings have risen through this year with net income of \$20,574,000, or \$1.79 a share, in the first nine months. The company with \$8,271,000, or \$1.31 a share, in the same period a year earlier.

## Combined Control Unit

Combined air traffic control unit and air defense center, both of its kind, has gone into operation at the SACF, American Forces, in Malmstrom AFB, Great Falls, Mont.

The new combination ATC and ADSC center will give Federal Aviation Authority control three operational radar units, and the new center will display that data through some 100 video display units, and computer-generated adjustment maps to each aircraft that show its altitude, altitude and other information. The center is providing close radar tracking of all radio traffic whether or not equipped with transponders.

The new ATC center, which replaces old FAA F-100 radar units, will have an increased control area encompassing approximately 620 sq. mi. in an area where there is a 100 sq. mi. in a conventional radar. FAA controllers will be in constant contact with the center via a display to read, understand, and act on. Airline Command and control traffic control operations. The new center is part of program called Northern Tier in northern region.





### What weighs 50 tons and can land in a bean field?

If you had been one of the spectators at Exercise Swift Strike III last August in North and South Carolina, you'd have seen it happen!

Big Lockheed/USAF C-130 Hercules airlifters, weighing 50 tons gross and more, made spectacular

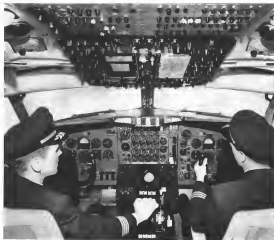
landings and takeoffs in hastily scraped bean fields and other rough spots. The rugged big birds made para-drops of men and material, too, through their giant rear doors. And, in a dazzling new display of airdrop versatility, the C-130s performed the new

cargo delivery technique—flying five feet off the ground and having cargo snatched out by hook and ground-cable through the C-130's huge rear opening. This revolutionary new method makes it possible to position strategic cargo precisely in clearings close to the action—where it's needed, when it's needed.

In addition to its over-all ruggedness, reliability, and rough-field landing and takeoff ability—the C-130's straight-in rear loading configuration keeps ground cycle time at a minimum. Today, 600 Hercules airlifters, in different versions, are in service—flying the colors of 7 nations.

LOCKHEED BIRDIA COMPANY, BIRMINGHAM, GEORGIA • A DIV. OF LOCKHEED AIRCRAFT CORPORATION

**C-130 Hercules**



## Sinclair keeps ahead— to keep aviation ahead

Keeping up with aviation's progress is a pretty hard job these days. Keeping *ahead* is even harder. But Sinclair Research takes pride in doing it.

From this research-for-progress here come many products of great help to aviation—Sinclair higher-octane fuels which gave piston engines greater

power—Sinclair jet fuels which jets used to break the sound barrier—special Sinclair lubricants which helped to put men into space.

Sinclair Turbo-S Oils are among these fine products. Major airlines rely on Turbo-S Oils by Sinclair, a leading supplier of quality aviation products.



### SINCLAIR AVIATION OILS

SINCLAIR REFINING COMPANY • 516 FIFTH AVENUE, NEW YORK 30, NEW YORK

## SHORTLINES

► Civil Aeronautics Board has issued the effective date of *Fast American World Service* T-100s (AW No. 15, p. 38) to Jan. 11 to provide airlines able time for reconfiguration. CAB also approved the certificate Sept. 24, but the certificate was not served to the board until Nov. 12.

► Federal Aviation Agency has issued its first Aviation Mechanics Safety Awards to John Matis of TWA in the air carrier category, and to Natus G. Soudakofsky of the McDonnell Douglas Co. in the general aviation category.

► Flying Tiger Line has reported a loss of \$667,190 for the first nine months of 1965, compared with net savings of \$2.6 million in the same period of 1962. Carrier reported a \$446,751 profit in the third quarter of this year.

► Midland Airlines has asked CAB for permission to adopt a Charge-A-Flight plan under which a passenger would pay a \$5 "administration" fee and board his flight. Passenger would pay for his ticket in three equal, monthly installments. For each \$10 of credit, the \$3 fee would be charged. No credit arrangements would be conducted, and only normal identification would be required to qualify.

► Northwest Airlines has reported net savings of 18.5 million for the first 10 months of 1965 compared with \$6.7 million reported in the same period last year. Total operating revenue rose from \$126.6 million to \$140.5 million.

► Seaboard World Airlines Co. reported a net profit for October of \$991,661, its first annual profit of \$2 million for the year. The airline has an order of 12 new Boeing 747s for the year.

► Trans World Airlines will avoid \$1 million in constraints next year for the expansion of ground cargo facilities at San Francisco, Los Angeles, Chicago, St. Louis, New York, Fort Worth, Houston, Miami and Reno. Contracts totaling \$328,000 for handling equipment have been let. Carrier's all-cargo jet service began last week on the transcontinental route.

► United Air Lines has developed a procedure that enables the carrier to check and wind turbine steel (oil used in flight recorder). Until the system was adopted, United spent some \$18,000 annually for the fuel in pre-owned spools.

## AIRLINE OBSERVER

► Federal Aviation Agency is combining its drive to sell U. S. supersonic transports in foreign markets in hopes of obtaining a substantial backlog of customer orders to support immediate development of the aircraft (AW No. 18, p. 45). Two position orders for B1 Ad and last for Northwest last week bring the total position orders accepted to 45. B1 Ad has been granted positions 10 and 14 in the prime North Atlantic market and Northwest has been given positions 16, 22, 29 and 35 in the secondary Pacific market under the FAA plan for assigning delivery positions (AW No. 4, p. 24).

► Scandinavian aviation authorities are studying a new point system designed to increase flight crew fatigue and improve flight safety. Fatigue points ranging from 0 to 10 for various duties in each hour are allotted, plus extra points for loadings. Limit of 168 points would be imposed upon each crew member per flight. Adequate rest periods could be taken from this point total. Application of the system would have its heaviest impact upon regional type routes requiring a large number of takeoffs and landings.

► Trans World Airlines will decide by the end of the year whether to carry a \$5 million hull insurance second during 1965 or assume or use it to act as a permanent reserve. The fund became available last month when TWA arranged for a special hull insurance policy on its aircraft for the balance of the year. Last year, TWA loaded \$20,471,470 in insurance to account in the fourth quarter, which produced a profit for the airline in a normally dark period.

► CAB has made its contribution to the current air law conflict. Noting that the third class line between Hawaii and the mainland (AW No. 11, p. 50) was 13- or 25%—less than regular coach fare, the Board decided to investigate the coach fare and may order a reduction of that rate. The Board assumed that the same difference between the two classes in the service of meals, and presumably concluded that 55% was a large amount to pay for a dinner or lunch. Meanwhile, United Air Lines filed a motion to the Federal Aviation Board and lower federal courts to nullify the proposed rule (AW No. 2, p. 47), but promised to file a "vigorous protest" against the plan.

► Russia reports that "one of the largest airport terminal buildings in the country" has been opened to passengers at Narvaik in the USSR's Kara-Sibirsk route. Airport facilities have also been improved at Tolmashov (formerly Almaty) in Kazakhstan to permit regular stops by Intercontinental flights flying the Moscow-Almaty-Alma-Ata route.

► Federal Aviation Agency is conducting tests to determine the accuracy of altitude and navigation equipment. The screenhouse program, called the navigation equipment capability analysis project, is being handled by Hamilton Electronics Corp. under an FAA contract and involves checks on about 1,760 VOR stations and DME and TACAN (interceptors) in aircraft through the U. S.

► Eastern Air Lines set a new record on its Air Shuttle operation by carrying 17,571 passengers on Nov. 27, the day before Thanksgiving. The record was previously broken on the following Sunday, when 16,199 passengers were carried on the Washington-New York-Boston Air Shuttle operation.

► San Francisco and Oakland Helicopter Airlines has been issued the first permanent certificate to be awarded any helicopter carrier. Certificate authorizes the carrier to serve the San Francisco-Oakland area without subsidy.

► U. S. airlines and all cargo airlines have reported a 16.5% increase in cargo ton miles for the first 10 months of 1965 over the same period last year.



If you've never driven a car with front-wheel drive, try the one that won at Monte Carlo.

The classic Monte Carlo Rally is a tortuous 2500 mile performance test crisscrossing icy alpine curves, hairpin corners, and hair-raising steep trails. Last January, a front-wheel drive SAAB took first place overall—for the second year in a row. And of the top ten cars, seven others had front-wheel drive, too. Significant.

SAAB's front-wheel drive applies full engine torque directly to the front wheels. No wasted power, surefire traction. You get better balance and flatter corners because SAAB has a near perfect center of gravity (low over the road). You get amazing traction wherever you go. And some owners get up to 60,000 miles on a set of tires. With the transmission up front, SAAB has a roomy interior and a flat floor, no dashpot, no dashpot hump. More space for you.

SAAB's front-wheel drive makes sense in or out of competition, in icy roads, in snow—anywhere you go. So does SAAB's new brake system (four independent master cylinders with hydraulic lines that diagonally connect front and rear wheels). Try a 1984 front-wheel drive SAAB at your nearest SAAB dealer soon. Only \$13,995, P.D.E.

\*Options, accessories and dealer cost excluded for 2 years on 14,000 miles.



Shipping Importer: Write for NE Distributive Sales, Dept. of SAAB, SAAB Overseas, Inc., Department 212, 605 Park Ave., New York, N.Y.

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Swedish Cars • Swedish Design • Swedish Quality

## Romanian Carrier Plans Tu-124 Purchase

By Edith Wallsted

Cosens-Transportation Aeronautica Bucuresti, Romania's national air line, plans to order Russian Tupolev Tu-124 medium-range, turboprop transport planes for its existing international network linking West and East Europe, its eastern and on sea routes (except in England, Ireland and the Near and Middle East).

Tu-124s also have to extend its routes to India and Indonesia when it can obtain long-range jet equipment compatible with other carriers already operating over those routes.

The jet also will allow the company to enter and its planned expansion of eastern charter services, a comparatively new but increasingly popular sector of its operations according to airline officials.

### Tu-124 Preferred

Like several other East European carriers, including LOT Poland Airlines, MAZ, Hungarian Air Transport and Tassair Belgium Air Transport, Romania's Tu-124s will replace its existing large transport with a seating capacity of between 44-56 passengers. The 75-88 passenger Il-18s it is developing recently entered service with Tassair in 1981 and its only jetliner entered plane.

Other Tassair aircraft include the Soviet Antonov An-2 turboprop planes and the L-7 and Ilyushin IL-14 transports. In comparison with the IL-14s, the new Tu-124s are scheduled to operate over the carrier's medium-range network and to replace the IL-14s, some of which are still in service on several eastern transit routes. The new jets also will be used to supplement the IL-18s on charter flights during the peak travel seasons of the year.

### IL-14 Use

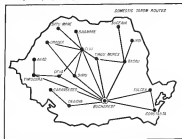
The IL-14s then will be assigned exclusively to the operation of the airline's internal routes as a much needed replacement for its obsolete L-7 fleet.

To cater to increasing demand for medium-range services, the carrier has also expressly needs several Soviet-built, 44-passenger Antonov An-24 twin-engine turboprops. In addition to Bucharest, its base base, Tassair maintains a total of 35 external airports located at strategic points throughout the country. Two of them, Sibiu and Constanta, were recently completed. Additional ones are planned.

Year-around service frequencies between each of these airports from a base of two to a maximum of seven round



TAROM HOPES TO EXTEND its present international route structure (above) to England, Holland, the Near and Middle East following delivery of its first medium-range turboprop transport. Long-range jet services on new routes to India and Indonesia are contingent. The carrier's domestic network (below) is served by IL-2 and Ilyushin IL-14 aircraft on a point-to-point basis, and a maximum of seven times daily round trip, according to demand for seats. The airline plans to cater to the increasing demand by converting new airports and accelerating the frequency of its flights in the near future.



trip flights daily.

In hopes of breaking into the large-range turboprop field, Tassair is studying the performance of Russian Ilyushin IL-62s as well as that of Britain's Vickers VC10.

A final decision on the type or number of new equipment has not been

reached and probably will have to await final government approval before orders can be placed, according to airline officials.

Romanian air services before World War 2 were practically nonexistent. Losses Romanian Air Lines, the former Romanian state-operated carrier, ac-





# The Spay is winning world acceptance

Production engine deliveries of the Spay are building up fast. And more and more airlines are showing firm interest in the engine for their re-equipment programmes. In its design and rating the Spay is based on Rolls-Royce's unique experience of 10 years commercial turbine operation. This ensures the operational economy vital for profitable use of the short-haul jet.

The Spay will bring to jet travel all the inherent qualities of the Dart project.

- 1** Flight testing of the Spay-powered BAC One-Eleven, entered by 7 airlines in 9 countries, is now proceeding.
- 2** The Spay has accumulated over 11,000 hours development running, including nearly 1,000 hours on the Hunter Sidemay Thrust.
- 3** Flight testing of the Spay-powered Hawker Siddeley Buccaneer S.2 since its start is now proceeding.
- 4** Spay-powered Conquest will be delivered to British United next year.

**A NEW PHASE BEGINS WITH ROLLS-ROYCE POWER**



**BOMANIK'S ONLY INTERNATIONAL AIRPORT.** Bucharest, near Bucharest, connects the Romanian capital with 16 other domestic and 14 international centers within West and East Europe, in addition to Moscow.

accounted for a total of only 9,445 passengers over its entire network in 1958. Following the positive reorganization of public facilities, including its transport, the national airline's name was changed to Taronc Romanian Air Transport. Since then, officials say, annual operational results have shown a slow but steady upward trend.

#### Network Grows

The network totaled 3,832 route miles in 1960. It grew to 4,331 in 1961 and to 4,541 in last year. Its monthly cargo, 5,387 metric tons—an increase of 45% over 1960.

Specific performance figures are not available, but according to the company the number of passengers carried in the last five years in its combined airline, travel and internal flights represented a 79% increase over the 1959 total, while the volume of freight transported had climbed to 1.5 times greater than recorded in 1959.

Tarom is using the owner's charter services, particularly to the popular Black Sea, Danube Delta and Carpathian Mountains resort areas of Romania, also increased steadily in recent years. The airline says that this has been over 15,000 visitors from West European countries including Scandinavia, West Germany, England, France, Austria, Belgium, Switzerland and Holland—three visited Romania on Tarom's charter flights in addition to large numbers from Soviet-controlled areas. The carrier says there is still plenty of room for further development. It intends to introduce a new standard service and generally improved charter service in its current status of attracting greater numbers of potential tourists to Romania.

The airline's present international

network connects 15 different European capitals with Bucharest and includes the following: B-24 and/or B-118 operated several trip services.

- Bucharest to Brussels via Vienna and Frankfurt/Main, twice a week
- Bucharest to Copenhagen via Prague and East Berlin, once a week

- Bucharest to Warsaw via Lodz, once a week

- Bucharest to Moscow, twice a week
- Bucharest to Athens via Sofia and Belgrade, twice a week.

In addition, the B-24 and B-118 fleet carries out very special charter flights anywhere within Europe as well as to a number of centers in the East including Egypt, India, Indonesia, Burma and China.

#### Agricultural Work

The company concentrates primarily on the transport of passengers and cargo, but its activities also include rapidly increasing agricultural and air ambulance services, although the Romanian health authorities are directly responsible for the latter. Tarom generally uses its An-2 utility aircraft for crop-dusting and pest control as well as for other multi-purpose duties. The company says its An-2 fleet is operating a total of 11,000 flight hours annually.

The airline's flight personnel and technicians receive their basic instruction locally. Crew members to be assigned to new types of aircraft undergo special training courses in Romania or at airports of the owner's greatest fleet of aircraft.

All servicing and intermediate overhaul work is performed and preceptions of the B-2, B-14 and B-118 aircraft is carried out either in Tarom's own or at

other workshops in Romania specializing in overhaul and maintenance. These units also are responsible for major airframe overhaul including engine changes in the B-16.

Average yearly utilization rate of each of the B-2 is 1,500 flight hours. The B-16 average, 1,200, and the B-118 aircraft average, 1,300.

#### SAS 1962-63 Profit Totals \$4,000,000

New York—Profit of \$4 million was achieved by Scandinavian Airlines System in the year ending Sept. 30, a sharp reversal from the \$4,750,000 deficit recorded for the comparable period of 1961-62.

Total revenues of \$130,400,000 represented a \$11,900,000 improvement over the previous year. Traffic revenues alone were \$140,300,000, \$12,100,000 more than in 1961-62.

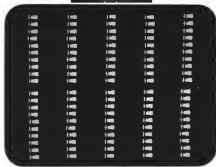
SAS now is one of the carriers leading most from the record success of tourist travel in Europe in 1963. Its average load factor was 80% both ways during the Atlantic June-May 1 through August. In June it averaged an 82.8% load factor on 139 scheduled flights, scored only to the 80.9% reported by Trans International Airlines. In August, SAS's scheduled load factor was 81.5% on 121 flights, again topped only by Irish with 96.8%. Load factor for the year was 71.5%.

The airline's expenses rose only about \$7 million during the year, totaling \$158,500,000. This left a gross surplus of \$21,900,000, from which \$17,400,000 was drawn for depreciation. The \$450,000 net made for profits was offset by \$200,000 from sale of surplus flight equipment.

"Telstar," the highly advanced astronomical observation satellite.



Radiography is used to inspect the solid rocket motor for "Telstar."



## It's got to be perfect to ride with Telstar

When Telstar beams and sees and responds, tens of thousands of ray guns must perform perfectly. Among these are the solid uranium capacitors, produced by Kemet Department, Lucile Company, Division of Union Carbide Corporation.

Highest quality is vital. So to have every possible assurance, this special breed of capacitor was radiographed in two planes. Radiographs showed whether the uranium anodes were positioned and pointed properly and

whether any stray solder globules were present which might migrate and cause a short circuit.

The space age has created one of the most exacting and extensive assignments radiography has ever had. Along with its use in inspecting castings and welds for soundness, comes the vitally important inspection of sealed internal assemblies.

Radiography gives assurance that only quality work is delivered, which helps build a reputation that attracts

new business. If you're interested, talk to an X-ray dealer or write to have a Kodak Technical X-ray Sales Representative call.

#### Two outstanding KODAK Industrial X-ray Films

**Type AA**—Fast, fine grain with high contrast. A widely used film for most purposes.

**Type M**—Extra fine grain, high contrast. Used where highest quality, critical radiating angle, is required.

**EASTMAN KODAK COMPANY**  
X-ray Sales Division Rochester 4, N.Y.



# WAVEGUIDES



Waveguide with 30" length, which carries a microwave beam as in our layout in microwave antenna input facility.



Waveguide in probe or antenna beam as shown in a microwave antenna input facility.



Waveguide in special transition which connects to a microwave antenna as in our layout in microwave antenna input facility.



Mill lengths are available from microwave antenna input facility.

■ In straight lengths or custom configurations, rigid waveguides offered by Phelps Dodge Electronics meet the performance standards called for in advanced microwave applications.

Bending and terminating waveguides into complex configurations at selected frequencies is a prime Phelps Dodge Electronics capability. Twists, bends, coils, offsets, transitions, fabrications and complete assemblies are customarily engineered to meet relatively unlimited specifications.

Twelve-foot mill lengths are available in 16 JAN and RCA wire. These pads are carefully extruded and drawn to precise tolerances from certified oxygen-free copper and commercial bronze, 90%.

Solutions to the most difficult, high frequency applications may well be found with the utmost in cabling, off-the-shelf or designed to your unique requirements, matched connectors, specially configured waveguides or cable delay lines. In addition to these turn-key components, Phelps Dodge Electronics offers capability in the development of subsystems for wave check-out and guidance, radar, telemetry, or any fixed network assignment in the microwave spectrum.

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## AVIONICS

### Relay 2 Designed for Enhanced Reliability

By Kenneth J. Sten

Hightstown, N. J.—First detailed description of structure, instrumentation and structural elements of Relay 2 do close voice modification designed to improve significantly the reliability and performance of the communication satellite, based on experience from Relay 1 in orbit.

Three of the changes, relating to power regulation and control circuitry, are calculated to produce a minimum of the loss of onboard power attributed to an unsatisfactory voltage regulator circuit during Relay 1's first days in orbit (AW Dec 24, 1962, p. 24).

In line structure and control, the new satellite, scheduled now for launch in late January or February, is identical to Relay 1. It will provide an all broadband communications bandpass appearing on the main frequency and essentially unchanged instrumentation and telemetry capabilities.

However, according to Richard P. Drapley, Relay project manager at Radio Corp. of America's Johns Hopkins Div., which built Relay 1 for the National Aeronautics and Space Administration's Goddard Space Center, communications reliability and performance are expected to be enhanced in these changes.

• Use of Non-P solar cells, in place of the Van-N type used earlier, to provide a significant increase in radiation resistance with a consequent lowering of the solar input power loss (AW Mar 4, p. 88). The Non-P cells should demonstrate only about 10% over 3 years from an initial output of 1.8 amperes down to 1.5 amp.

Output under radiation for the Non-P type level off approximately from a similar initial value of 1.8 amp after launch to about 0.9 amp by early September, Drapley said. Current given as output from the solar cell area, and are also available to the d.c. cables in the high-power transmitter voltage regulator. Use of the Non-P array makes the mechanism of energy transfer less sensitive to transients.

• Selection of transistors for the high-power voltage regulator to avoid the deep-potential characteristic that made it impossible to turn off one power supply in Relay 1 until the battery voltage dropped to an abnormally low figure during the satellite's first two weeks in orbit. This failure was attributed to an apparent change in the characteristic

of the 2N1738 transistors, originally used in this circuit as a function of very low temperatures.

At approximately -20C, the collector to base leakage current ( $I_{CB}$ ) rose sharply (see sketch, p. 88), and the light-duty transistor would not turn off. As a function of time, the battery voltage dropped, causing a reduction in the heat dissipated into space by the transistor. Its temperature eventually fell below the critical point and the transistor turned off. RCA engineers confirmed their theoretical analysis of the cause and effect sequence when the battery voltage had increased to normal value. On Dec. 27, they once again turned on the transmitter voltage regulator and once again, once results, it turned off. The cycle of lowering voltage and heat dissipation caused it to shut off on Jan. 3. Since then, the unregulated power supply has not been used and all power has been taken from the back-up supply, Drapley said.

The Relay 2 power supplies substitute an electrically regulated transistor, type 2N1358, for the 2N1738. RCA

sampled the entire industry and selected transistors that do not exhibit the deep-potential characteristic that caused the earlier problem.

• Addition of magnetic latching relays to the power supply for the broadband communications system to provide "redundant reliability" by providing a secondary means of turning off the power supply by ground command in the event the 2N1358 transistor develops characteristics that repeat the earlier experience.

This change was made only after a considerable amount of discussion as to whether the new circuit component would introduce added mechanical shifts into the Relay system. The magnetic relays have been used in aerospace applications for a number of years and the obvious consensus was that they would be beneficial, Drapley said.

• Addition of temperature sensors in the battery area of the satellite, in close proximity to the physical location of the 2N1358 transistors in the voltage regulator, to provide a means of determining, through ground telemetry, when



RELAY 2 SATELLITE is tested in environment test chamber at Radio Corp. of America's Johns Hopkins Div. Hightstown, N. J. Tests of the new NASA satellite and its components included operation of the new experimental leveling wave tube in a simulated vacuum environment for over 1000 h.

## SERVO COMPONENTS



Our publication "Technical Information for the Engineer" Number 1 was written and published for two major reasons. First, as the nation's leading innovator and producer of precision components, we wanted to sell more of them and secondly, some time ago we recognized that although textbooks on servomechanisms were very complete, the field suffered through a lack of uniform terminology and tests methods. We attempted to cover the theory lightly in our book with major emphasis on terms, applications and component behavior from the user's point of view. You may obtain a copy of this 60 page booklet simply by writing to us.



**ComPac E SERVO ASSEMBLIES.** Kearfott's advanced Size 8 component designs have made possible the most complete variety of in-line servo assemblies available. The ComPac E units,  $\frac{1}{2}$ " in diameter, provide high performance "closed and" devices incorporating a wide range of driving and driven elements coupled through accurate single or dual speed gear reducers.

System designs based on the ComPac configurations benefit from high packaging density, and alternation of provisions for the multiple mounting of independent elements and gaskets. A typical ComPac configuration of a servomotor—gear reducer resistor and potentiometer combination measures only 3 inches long and weighs 3 ounces.

Size 8 components available for ComPac assemblies:

- Motors — Servo, Stepper, Broken, Inertial and Viscous Damped.
- Motor Generators and Transmitters.
- Synchros and Resolvers — Transmitters, Transformers, Differential Transmitters, Resolvers, Linear Synchros, 4 wire Synchros.



**SIZE 8 COMPENSATED RESOLVERS.** Winding compensated Size 8 and 11 resolvers and matching Size 31 buffer amplifier are also available from Kearfott for high precision computing resolver chains. Tuned for unity transformation ratio, the resolver-amplifier combinations provide TR of 1.0000  $\pm$  0.0007 over the temperature range of -55 to +125°C, frequency variation of 400  $\pm$  20 cps and voltage variations from 0.5 to 20 volts or simultaneous combinations of these variations. When used with size 8 resistors the sensing mounted size 31 buffer can be installed adjacent to the resolver. A "Piggy-Back" tandem assembly of the Size 11 resolver and buffer amplifier is available as well as separate Size 31 resolver and servomounted Size 18 buffer. Additional characteristics of the combined buffer-amplifier assemblies are as follows:

Size 8 Resolver	Amplifier	Resolution
Phase Shift After Amp (1)	Gain	Resolution
0.007 $\pm$ 0.001	0.015	0.01 $\pm$ 0.01
Size 11 Servo (1)	Gain	Resolution
0.007 $\pm$ 0.001	0.015	0.01 $\pm$ 0.01

\*This value constant over wide temperature, frequency and voltage range



**4 WIRE SYNCHROS.** High system accuracy using Size 8 components is made possible through Kearfott's 4 wire synchros. Mount as resolvers, but with appropriate electrical characteristics to permit their use as transmitters, differentials or control transformers. These components can be directly applied in feedback loops without the use of special buffer amplifiers. Features individual component accuracy of 3 minutes of arc from electrical zero, when these components are used in a typical 3 component string, overall accuracy will be approximately 0.2 minutes of arc from 02 Designated R2, R2X and R2C corresponding to transmitter, differential and control transformer respectively. The specification of these components to your analog computer devices will contribute to increased accuracy, while reducing volume and weight. Suitable for high vibration (2000 cps 20 g's) and high temperature (200°C) environments can be provided on special order.



**STEPPER MOTORS.** Size 8 stepper motors provide unambiguous shaft position corresponding to a sequentially pulsed digital input. Positive positioning of shaft through a magnetic detent rather than mechanical devices contributes to the reliability and performance of these motors by eliminating shock loading and mechanical wear. Accurate and positive shaft position makes this unit ideal for application in counting, positioning and switching mechanisms and in applications involving the use of two motors in a self-aligning manner. The latter application permits a form of closed loop servo operation from a digital input.

Typical characteristics include: 400 pulses/sec response rate, 0.60 in. oz. holding torque, 0.30 gm/cm<sup>2</sup> motor moment of inertia, 25V excitation, other values available. Overall dimensions:  $\frac{1}{2}$ " diam x 0.875" long, weight 1.5 oz. Compatible welded electronic switching assemblies can be provided for driving these stepper motors. Other motors in various frame sizes are also available.



**ANALOG MICROELECTRONICS.** We've looked around and have not been able to find anything to compare to our new Hybrid Microelectronic Servo Amplifier. It delivers 5 watts into a Size 15 motor or motor generator and is only  $\frac{1}{4}$  cube inch in volume. This amplifier combines the best of vacuum deposited techniques with discrete components to provide a highly reliable device. It will deliver a full 5 watt output in ambient to 71°C and 3.5 watts in an ambient of 100°C. A highly efficient hermetic mounting surface assures adequate heat transfer and electrical isolation. Gain is adjustable through the use of an external resistor over the range of 100 to 1000. The output is 40 volts nominal and the gain stability over the temperature range is  $\pm$  3%.

This amplifier will drive Kearfott's size 8, 10, 11 and 15 servo motors and motor generator combinations.

**GP GENERAL  
PRECISION  
AEROSPACE**

**KEARFOTT DIVISION  
LITTLE FALLS, NEW JERSEY  
07643**



## Consist Developments

Many space experiments and developments are needed to span the gap between experimental vehicles like *Kelley* and, instead, full-time communications satellites, according to Richard P. Donnelly, Kelly project manager at RCA's Aero-Electronics Div.

Now underway research contracts being conducted by the Defense Dept., NASA, the Communications Satellite Corp. and others, Douglas listed the following items as what he considers most of the pressing satellite objectives:

- Multiple access transponders which would permit a number of ground stations to communicate with a number of other ground stations through one satellite. There is a real need for systems experiments and additional exploration of modulation and multiplexing techniques.

- Directed beam antennas. Since spacecraft are generally located at power due to weight and size considerations, directed beam antennas could give increased capability to satellites.
- Higher efficiency traveling wave tubes.
- Higher efficiency videtur capability.
- Station keeping, ability to place satellites with respect to other satellites.
- Multiple launching experiments. Developing a capability to launch a number of satellites with one booster.

remote transmitter at the Narvik, N. J., ground station operated by NASA and International Telephone & Telegraph Corp. has been increased in power by a factor of 10. Command and control of the satellite from this location is handled by NASA personnel, with ITT operating the communications facilities at the dual station on the company's grounds.

- Addition of shaping beams to overcome misalignment of equipment beams aimed at the satellite. This capability appeared on the *Kelley* prototype, which was tested under a considerably wider range of elevation and temperature than the flight model. Two tubes, one of which aligns within the other to focus

them as a shapable spring, damped out some of the vibration extremes experienced with the prototype.

*Kelley 2* will be launched into an orbit with a higher perigee—about 1,000 mi compared with 700 mi—than its predecessor, but its apogee will be about the same, 4,600 mi. Radiation from the equator will be 47 deg. View over equator, the satellite to attempt Van Allen belt radiation, which is believed to peak at about 1,000 mi. Most of *Kelley*'s sensitive components are shielded in boxes designed to prevent satellites effects, according to Douglas.

Antenna configurations on *Kelley 2* will be the same as *Kelley 1*, using a 1.5-ft center mast which acts as a dual transmission line. RCA proposed the NASA some months ago a de-spun antenna design which would use a screw loop to look down the local vertical at all times. Such an antenna could pro-



**SHARP RISE** is collective loss leakage current (L.L.) at about -200 was the result of uncorrelated deep-point characteristics of 2N154A transistors that were used in the power supply of *Kelley 1*.

vide about 10-db gain, at the expense of about 5.0 lb additional weight and about 5 w power consumption, Douglas said.

## FILTER CENTER

• **Low-Altitude Penetration Radar Studies**—Polaron, design studies of low-altitude surface penetration radar capable of providing terrain avoidance navigation and ground mapping functions over a range of weather conditions are being conducted by Aerospace Div. of North American Aviation and Raytheon Co. as part of Phase 1 contracts from USAF's Aeronautical Systems Div. The radar is to be light weight units, probably requiring extensive micro-miniaturization of the type Aerospace is accomplishing in its own funded R45 navigation and attack radar developments (AVF June 17, p. 90). Antenna's penetration radar may be an outgrowth of the R45 line. ASD is expected to conduct a Phase 2 design competition in the completion of the Phase 1 studies early next year.

• **Radar Counter-Countermeasures**—The susceptibility of radar and guided missile firing systems to hostile countermeasures will be evaluated by Cook Electric Co. for the Navy. The company will be expected to research and develop countermeasures against measures to offset any vulnerability to countermeasures of the system against grid.

• **Superconducting Generators**—Feasibility of a superconducting generator will be investigated by Dewitt Corp., Cambridge, Mass., under contract to Air Force's Aeronautical Systems Div.

• **Confidential Device Construction**—General Pattern—Consistent Device Corp., one of a handful of semiconductor companies which has shown a record of profitability and growth throughout the last few difficult years in

the semiconductor industry (AVF Sept. 23, p. 56), reports sales of \$10,190,706 for the fiscal year ended Sept. 30, compared with \$6,130,660 for the previous year. Net income after taxes was \$750,974, compared with \$708,081 for the last period last year.

• **Helicopter Cockpit Display**—Douglas Aircraft Co. will develop an advanced cockpit display system for use in Army helicopters under a \$1,362,000 contract from the Army Electronics Laboratory at Ft. Monmouth, N. J. The work is a continuation of earlier efforts for developing aircraft conducted by Douglas for several years under the Army Navy Instrumentation Program (ANIP).

• **Myoelectric Control Studies**—Polaron Corp. has received a \$54,785 contract from Office of Naval Research to investigate feasibility of using electrical potentials on the surface of a human's skin for control functions. A somewhat similar effort, under which the potentials associated with shoulder muscle contractions were used to control a servo hand system (AVF May 25, p. 69), recently was referred at Springfield, Mass., by USAF's Research and Computer Branch at Aeronautical Systems Div. The technique is thought to have unusual aerospace and medical applications, particularly in sensitive portable devices.

• **Detecting Missile Launches** by Sonophysics—Changes in kind of sonophysics data banks which are being a hollow missile launch will be preferred by Acrophysics Research Corp., Los Angeles, for the Office of Naval Research. Changes in the atmosphere in a result of missile launches may provide



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**OPTIMIZED** traveling wave tube, developed by RCA's Blount Electron Tube Div. is a result of its experience with *Kelley*, is an improved design capable of producing between 2.20 w, depending on how load with power efficiency was tested. Weight is about 3 lb.

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## BALLOON FEVER

"It was essentially owing to Lieutenant von Eschwege and the Luftwaffe that we were able to hold the enemy near or less in check." So recalls Germany's *Der Welt* in its Air, an impartial chronicle of World War I German pilots.

The pilot in question was an arrogant, ambitious, 23-year-old Prussian who, with a handful of other German flyers, manned an air station in France, Greece—a key Macedonian point along the Balkan Front.

They supported the Turks and Bulgarians against a common enemy—the English, French, Italians, Serbs and Greeks.

Von Eschwege had as few as five planes at one time. The Royal Flying Corps had forty or fifty. But all by himself, the war-spoken Lieutenant earned the accolade. That's why, like him or not, both sides called him "The Eagle of the Aegean Sea."

A former trench soldier, he returned to the infantry as cannon fodder. He proved to be fierce and fought with a ferocity that was more fearful than courageous. Yet, in his 23 months in Greece—from June 1916 to November 1917, he shot down 17 British planes and three observation balloons.

In one of his most famous exploits, he singlehandedly upset

a bombardment of a German sea base. Right British warships were shelling the port city of Corfu. Their target was a Turkish, disdaining 4000 feet up and guarded by seven Spanish frigates. Von Eschwege attacked the German and sent it into the sea, right under the noses of its protectors.

Von Eschwege's favorite plane was the Heinkel He 111. Powered by a 120 h.p. Argus engine, it was 24 feet long, had an upper wing span of 36 feet, and was armed with two synchronized Spandau machine guns capable of firing a total of 1200 rounds.

It was in a Heinkel that von Eschwege taught "balloon fever"—an often fatal illness usually contracted by passengers, most aircrew pilots.

The illness begins when you come upon your first enemy observation balloon bobbing lazily in the sky, like a fat, gray sausage you can't wait to bite your secondary balloon hole.

The balloon itself was no problem. It was as big as a barn and just as dumb. The enemy hanging underneath it didn't even have a pistol. The pilot designer was on the ground. The British gunners, called *Archie*, sent their eight pound rounds, ready to shoot down any plane foolish enough to fly near a balloon.

The naive Lieutenant von Eschwege began his first big air October 18, 1917. He cut the jump as the *Archie* by diving out of the sea, throwing down his engine and gliding toward his target. But Spandau springs fire. On the first pass, the observer jumped out of the strong new's seat and parachuted to safety. On the third pass, the balloon caught fire and fell in a blazing mass to earth.

On November 9th, von Eschwege attacked his second winner. Twice he saw his balloon pry push the grey skin. But Gray was no fire. He did have a victory of sorts. The observer's plane didn't stop.

By now, the *Archie* were on to him and von Eschwege's plane was riddled with bullets. A young, less experienced pilot would have called off his war with the balloons.

But, six days later, von Eschwege saw his second balloon go down in flames. That time, every *Archie* sight was on him, but he returned to Greece without a scratch. On November 19th, his balloon burning was intercepted by a Sopwith Pup and a B.E. With one burst he destroyed the B.E. The Pup escaped his fate.

Governed of his invulnerability, the Eagle of the Aegean Sea went after another balloon on November 21st. He found it above the town of Delphi, held to its height at 2000 feet by a single heavy cable. As before, he dived at the balloon from out of the sea, thanks

to a lone fire detector and early warning of missile attack.

That, as he pulled away from the balloon, exploded in a fiery ball that broke the Eagle's wings and sent von Eschwege to his death.

Late, it was learned that the British had an a trap for him with enough explosives to that balloon to destroy a plane a hundred yards away. The blast was set off with its elevator signal from the ground. The *Archie* didn't shoot because they didn't have to. The observer couldn't jump. He was a mass of steel.

### Clever trick, wasn't it?

It was indeed. But experimenters here to try something different to our need. Of course, they wasn't at all sure they'd make it work. They didn't have to meet mid open for that sort of thing.

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a lone fire detector and early warning of missile attack.

■ **USAF Computer Standardization**—Report to industry groups, to supply standardized data processing equipment at five major USAF command headquarters is expected to be issued this month by Electronics Systems Div., Hanscom Field, Mass. Total of 10 computer manufacturers have been asked to submit their interest in building for the program. Contract of \$30 to \$40 million.

■ **Component Sales Rise Slightly**—Fifty shipments of electronic components by U.S. manufacturers during first three months of 1983 were up 1.5% over the same quarter of 1982, according to figures released by Commerce Dept. Largest increase was found by "complex components" such as microprocessors, amounting to 250%. Shipments of connectors were up nearly 11% and quartz crystals were up 5%. Recovering taken were down 12%.

■ **Lower Dells They Hides**—Use of laser to drill holes only 0.015 in. in diameter in his case was reported by Dr. Donald V. Moore of Northstar at Intel's National Electronics Conference in Chicago. But he noted that unless energy is precisely focused, the center was a vaporized. Rayholes he used have to drill concentric and reproducible holes in various metals when an x-ray radiation was properly controlled, achieving depth-to-diameter ratios as high as 10:1.

■ **High Power Pulse Via MHD**—Optoelectronic hydrodynamic (MHD)



### Millimeter Antenna

Millimeter wave antenna for making sensitive observations of solar bodies, planets and extraterrestrial objects and for conducting geophysical studies, will go into operation soon at Ames Research Corp. At Sausalito, Calif. Antenna has a pointing accuracy of 30 sec of arc; initially will be able to operate at 94 ghz; later, it should range 95 to 100 ghz.





## Woomera Readied for Blue Streak Firing

By Herbert J. Coleman



**BLUE STREAK**, test stage for the European Launcher Development Organization space vehicle, is hoisted into position at Launch Pad 6A, near Lake Hurst on the Woomera range.



**VIEW OF PAD 6A**, under construction at Woomera, shows the dense outfit devoted toward the flight tests. Outfit is lined with activity film house with a too many in the area to be used for film making.

Woomera, Australia—Launching Pad 6A, located 175 ft above a windswept, red-earth dry lake escarpment near this remote community, is rapidly being constructed to put Australia into the world space effort sometime next April—when the fast Blower Sledge Denney Blue Streak launcher will be test-fired down this immense range.

Major city was taken last week when a Blue Streak development launcher, designated Denney A, was stockpiled for 3 sec, to prove out the supply, instrumentation and emergency shutdown system at Pad 6A. Another test will be made late this year.

At the same time, the actual fast road, designated Blue Streak F-1, was stockpiled for 10 sec at the British Ministry of Aviation's Spadecolter research establishment, near Cardiff, Scotland. The launcher is being prepared to Hawker Sledge Denney's plant at Shoreham for final inspection before being shipped by sea to Australia.

In other moves to put the European Launcher Development Organization (ELDO) into business at Woomera, Australia officials:

- Built a special bridgehead building near Pad 6A, to store Blue Streak test stages, the chronic second stage (French Denney) and the Car was developed (third stage).

- Are considering construction of a special ELDO village of about 60 houses, pending a permit staff bank down on nearby British. ELDO personnel will be housed at Woomera Village, 10 mi. from the range head, with special mass facilities available separately from existing senior staff and junior staff messes.

- Range instrumentation down the Blue Streak flight path is being checked out and new rules being added. Actual flight will be about 150 mi.

- ELDO staff personnel have begun arriving at Woomera Research Establishment, at Salisbury, the Woomera administrative branch, for planning talks with range officials on housing, office and supply needs.

- Woomera officials, in a separate program, are studying possibilities of moving a Black Knight research rocket to a Blue Streak for possible use in upper atmosphere research for United Kingdom communications satellite system.

But with Launching Pad 6A nearing completion for its dual role of first stage

and ELDO vehicle firings, the Woomera staff is concentrating on the flight plan for the April test shot. The sequence will be:

- After liftoff, Blue Streak will fly vertically for 20 sec. to a height of about 4,000 ft. It will then begin to veer over in the direction of Teligny (see map, below) at the rate of 7 deg/sec, until the flight path is at an angle of 10 deg to the horizontal.

- Blue Streak will continue flight at this angle until the Rolls-Royce RL2-2 motor automatic thrust at 115 sec after launch. The vehicle will then have achieved an altitude of about 45 mi and a range of about 66 mi from the launching pad. Its speed will be Mach 11.

- At reaching Mach 11, the main tests will have been completed but the Blue Streak will continue to fly to an impact point 510 mi from Pad 6A. Speeds will occur at and range between 500 and 600 mi. Vehicle weight at liftoff will be 208,273 lb. Total test thrust will be 278,000 lb.

W. K. Bawell, director of the Woomera Research Establishment, and the second and third launches will carry lead weights to simulate the second and third stages. However, the fourth Blue Streak launch will include Denney second and third stages to simulate the complete ELDO vehicle.

Bawell said that before ELDO attempts to put its first satellite into orbit, the organization plans at least eight development firings of the vehicle. The first two stage launch will be conducted near the end of 1965. A Denney satellite is now under construction at Italy for the program.

Despite the emphasis on Blue Streak and the ELDO program, Woomera was designed as a general-purpose range. Bawell pointed out that the weekly average is four trials a day on various missiles and rockets under test for United Kingdom use. Is the upper atmosphere program.

- Saunders-Roe Black Knight has been fired 15 times without a catastrophic failure. Six Black Knights entered a downward firing sound stage as part of a study to determine seismic characteristics at hypersonic speeds. One Black Knight now is being instrumented with Blue Streak components for a firing with test use.

- Black Skyhawk is being readied for a series of upper atmosphere soundings, instrumented with British university and meteorological equipment. Another is under construction for firing when the British UK-2 satellite is launched next year. That will provide an independent check on the satellite's cosmic measuring instrumentation. Firming will coincide with a UK-1 pass over Australia. Nowest program is the Skyhawk series, in which the vehicle will be decontaminated on the run. A following



**BLACK KNIGHT** is being prepared for a planned series of Blue Streak development trials at the Australian range.



**DEEP SPACE TRACKING STATION**, operated by National Aeronautics and Space Administration by Australia technicians, includes 85-ft. dish and a part of Maitland dish.



**WOOMERA RANGE** stretches across about 1,210 sq. mi. to the Coast South Coast in Western Australia, impact point for the first Blue Streak firing in April.



## How many airplanes are in this picture?

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ward area bases. In operational squadrons, it will require considerably less man-hours of aircraft maintenance per flight hour than other supersonic fighters.

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**Dow Corning**

the village. This cage was designed to allow maintenance crews and loading of a number of payloads at one time, such as Sea Slug, Black Knight and Sky link, Thunderbolt 1 and Thunderbolt 2 surface-to-air weapons and CF 100, a new ship-to-air weapon under development by Hawker Siddeley.

Another new weapon is called Horn, which will be used in air submarine warfare. No details are available on it.

The British Blue Steel, stand-off weapon for the V bomber force, still is under test, although it was declared operational last fall. A Royal Air Force train operates from Edinburgh field and during a visit by the American Wesc & Seavey Technology office attempted a demonstration, drop which was cancelled by the pilot at the aerial point. No reason was given other than "incompatibility" between weapon and the airplane.

Boswell claimed that Woomers is the most heavily instrumented range in the world. There are more than 200 data collecting points, including radar on radar antennas and theodolite cameras. He said that with additional "accuracy" of the entire range will be required.

It is for this reason that the British government is negotiating with Austria to use Woomers for flight testing the TSR 2 tactical strike reconnaissance air-

### Woomers Village:

Woomers village, located about 300 mi. northwest of Adelaide, is a modern community administered by a municipal council who is aided by a Woomers board of elected residents, various departmental appointees and a permanent secretary.

The village is in arid desert country which has a rainfall of only about 7 in. a year. Despite this, considerable numbers of sheep graze nearby. A successful working system has been set up to control movements of sheep and lambs during hot days, and a number of sheds have been built. They are easily used because, as one Woomers official put it: "The broken fences to the hills fit, since it breaks the country."

Single employees are fed in messes, according to junior or senior status, and individual housing for single employees is provided at nothing extra. One of these small, six covered beds had a sign over its door proclaiming it "my Miss area."

Facilities at the village proper include a swimming pool, super market, florist, chemist, police and fire stations and schools. There is a small movie theatre, kindergarten and an inn, so convenient to encourage the growth of shorthere, and have capable of meeting temperature extremes.

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MIT/RAYTHEON STATUS REPORT:

# APOLLO Guidance Computer



Ralph Baran (left), Manager of Raytheon's Subsystem Operation, and Eldon Flork, Director of Apollo Computer Division, MIT Instrumentation Lab, inspect on-board guidance computer for Apollo mission.

## Predicted Reliability Increased More Than 2:1 ...Contract On Schedule

By incorporating the latest rope memory module and integrated micrologic techniques into Apollo's on-board guidance computer, the MIT/RAYTHEON team has doubled predicted reliability of the system with no loss in scheduling time.

Drawing upon a background of successful joint effort in developing the reliable Mark 2 Polaris missile guidance computer, the MIT/RAYTHEON team is striving for similar fault-free operation of its Apollo guidance system. The operating computer, less than 1 cubic foot in size, will provide mid-course navigation and guidance data for NASA's Apollo spacecraft mission.

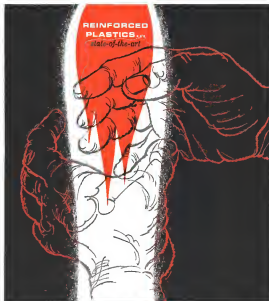
The MIT/RAYTHEON-developed computer contains an extremely dense, low-powered, fixed memory of 8,000 bits/cubic inch. In flight, the astronaut will operate the computer through a 16-button coded keyboard. In case of input error or an "unacceptable" order, a light will warn the astronaut to erase the error. When the command is correct, he pushes an "enter" button and the computer will take over, using inputs fed to it automatically from the other subsystems in the craft.



Keyboard for Apollo's on-board guidance computer.

The working relationship of the MIT/RAYTHEON team in developing and producing the computer, its displays and keyboard, and its pre-flight ground support equipment, represents a truly unique capability in space age guidance and control. Space and Telecommunication Systems Division, Sudbury, Mass.

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quish (AW Nov. 4, p. 14). It will be based at Edinburgh field but will use the length of the Woomers range for tests at both high and low altitudes.

Data processing is centered in an IBM 7090 computer, installed in 1967 to replace a British-built Wessex digital computer. Another computer still in use, was built by Woomers technicians when the Siroc was being developed as a military weapon. Borell said the unit cost one third of the IBM 7090's price and ran for 400 hr. before a transistor failure shut it down.

#### 7090 Operations

The 7090 runs for two full shifts a day and is in continuous operation from 9 a.m. to midnight. Technicians figure that on the basis of present Woomers growth, the 7090 will have to double its operations. It now does 50% data processing and 90% weapons research. The remaining 10% is allocated to a few government departments and to industry and universities.

A considerable portion of the up to one-half million bits of data gathered a day at Woomers comes from upper atmosphere research sounding rockets, a program which will be expanded next year.

Siroc now is being modified to take a heavily instrumented 200-lb payload with the entire nose package recovered by parachute.

The establishment's flight program group, now concentrating on the land from 140,000 ft. to 500,000 ft., plans to experiment first with spin-up wing. Two sounding rockets to set up ground instrumentation. Later two-stage rockets called HAT (high altitude test) and HAD (high altitude dummy) took payloads of up to 35 lb. to 460,000 ft.

#### Density Measurement

The group currently is developing a Moler current balance which will be capable at 200,000 ft. to float down to the ground on a specially designed parachute. Its main instrument will be a gauge developed by the group for measurement of low density. Temperature sensors will be included in the package.

Techniques and the balloons, which will be adapted to payloads of one to two hundred lbs., will drop at 2,500 fpm.

In cooperation with the University of Adelaide, the program group is preparing a series of studies on ultraviolet absorption in the alpha-alpha region, in which a helium flare used in the instrumented head filter out all but human alpha radiation.

An integrated part of the Woomers trail is a Javelin target drive squadron, operated by the Royal Australian Air Force. The squadron also is equipped with dense and plastic versions of the



Composite Photo of Lunar Surface

Composite photograph of lunar surface was assembled by USAF's Associated Chart and Information Center, St. Louis. Map, from previous issue of *McDonald*. Mr. Wilson said the Mole observations, "Mooling" of moon on its run during its elliptical orbit—a factor called libration—has been noticed in composite in a same position by use of several positions pictures. Libration position on the moon which has been measured and established in increments, under to position position on the earth's surface, was used to control position of balloons in composite. The photo has been processed with work at key to combine with standard orientation of earth maps.

#### Conquest and Meteorite

So far, the equation has flown 1,134 Javelin flights. Its last altitudes average to 17 or 18 flights. On Javelin has flown 62 missions and has been operated at high to 65,000 ft.

In an effort to measure altitude range, a single Javelin is being modified to take a Royal Saddle, under water group 100 lb. thrust for water capsule.

Major degradation in BS-1001 and tests will start next week.

#### Cambridge Research Efforts Are Outlined

Washington—Twenty-two research projects costing about \$2 million have been authorized from special funds, on the Fiscal 1964 budget of the Air Force Cambridge Research Laboratory. The projects include:

Expansion of research on methods for testing and reducing water de-

position on the moon, microanalysis of 10 Nite Apollo rockets to study particle concentrations in the E region of the ionosphere, correlation of Doppler weather radar on an aircraft to study air masses within thunderstorms, and correlation of a 28-ft. solar radio telescope at the laboratory's Squamish 380 observation for studying the velocities of solar radio emissions.

They also include investigation of photochemical reactions taking place in planetary atmospheres which give rise to negative ionospheres, measuring ionospheric plasma to make background ionosphere measurements in the ultra violet and infrared regions, construction of an interferometric spectrograph to study infrared transmission through the atmosphere, investigation of the bonding number of materials under ultrahigh vacuum conditions, laboratory study on infrared radiation from condensed amine tanks, and observations necessary to develop an Arlin or infrared orbital background.



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## Cut backup insulation weight up to 60% with J-M Micro-Balloons

In the missile and space field, weight counts money. Therefore, the more you reduce component weight, the greater the savings. One of the major areas where this economy can be obtained is backup insulation. With the development of Micro-Balloons, Johns-

Manville offers a way to drastically lighten this load.

Micro-Balloons are minute bubbles of either silica or phenolic. They form a structurally strong, extremely lightweight building agent that can be utilized in many ways. For example, they are used in J-M Thermostat® 383. This phenolic-substrate winding cut, it is approximately one-third the weight and one-third the thickness of conventional materials, offers an equal shielding

effect at 350°F mean temperature.

Another example is J-M Micro-Balloon® D, an asbestos-based refracting felt used as a lightweight non-reinforcing for Bakelite materials. It is ideally suited for both laminating and tape winding.

For full details on the many uses of J-M Micro-Balloons, write to Johns-Manville Products Group, Johns-Manville, Box 14, New York 16, N. Y. In Canada: Port Credit, Ontario, Cable: Johnsmanvil.

THE NAME TO THINK OF FIRST FOR ARGONITE

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**We left the gears and shafts out  
of our new solid state transceiver,  
and what does it get you besides  
lighter weight and smaller size?**



**10 times the reliability!**

Gears are the troublesome mechanical parts, replaced by reliable solid state components. You even have noise immunity and "instantaneous" with the new Bendix® RTA-41 VHF Communications Transceiver. MTBF projects to show 2500 hours: ten times the reliability of earlier equipment! Built-in monitor and self-test circuits give you a valid confidence check.

Of course, you get all the other benefits of solid state design in the RTA-41: low weight (37 lbs.), smaller size (short, one-half ATR), low power drain. Transmitter output is 55 watts minimum; receiver sensitivity, better than 2 microvolts for a signal-plus-noise to noise ratio of 6dB.

You also get Superflexibility, a Bendix development Check

switches the receiver when there's no signal, even in high-noise areas. It'll open an signal as low as 10dB below noise level. You simply set it, once, forget it. The RTA-41 meets or better all AEC/DOE requirements. It provides 358 crystal-controlled channels (50 kc spacing) in the 118 to 136 mc range (RTA-41A) or 680 channels in the 116 to 158 mc range (RTA-41B). Either version is also available with 55 kc channel spacing.

We developed this one for second-generation jet aircraft. Several airlines have specified it already. Its size, weight and price qualify the RTA-41 for business aircraft, too. We'll answer all your questions if you'll write us at Bendix Radio, Avionic Products, Baltimore, Md. 21204.

**Bendix Radio Division**



Thiokol Chemical Corp.'s XM-42 acceleration model, for USAF Boeing X-30 (Dyna-Soar), undergoes full-scale static firing.

## **Dyna-Soar Acceleration Rocket Static-Tested**



Following completion of the XM-42 development program next year, Thiokol will build 25 of the motor for preliminary flight testing (PFRFT). Delivery of operational motors is scheduled to begin in 1965. In photos above, workers fit landing harness around XM-42 motor case prior to loading it with propellant (left), and after propellant is poured and cured, photo-control, photo-optical control is verified (right). Forward-reared XM-42 leaves environmental chamber (below, left) where it underwent temperature cycling tests from -100° to 150°F. Before final assembly and static firing, motor components are subjected to salt spray, sand and dust, humidity and vibration. Motor is shown (below, right) after static firing. Thrust vector control nozzles, supplied by Aero-Portland, Inc., deflect thrust up to 30 deg. 15 sec. in plane of thrust at angular velocity of more than 50 deg./sec.





Phantom II fuselage section (above) and subfloor (below) being assembled at Republic Aviation Corp., under subcontract for McDonnell, use 25% titanium, most welded jet weld heat

## Titanium SST concepts get rugged test on fabulous Phantom



### Tomorrow's design problems being solved by today's Navy-Marine-Air Force Fighter

Broken in the mid section of the McDonnell F4H/J-4C Phantom, look where the hot jet valve into the thermal pipe, are titanium struts. Like a bowed transmission, they carry stresses to tomorrow's Mach 3, high-performance aircraft.

A total of 531 pounds of titanium is used in the aft fuselage section alone—more than 25% of its weight. It is used in key areas—where its strength, stiffness, and resistance to fatigue, thermal stress corrosion are needed to stand up under high loads in intermediate heat ranges up to 900°F, with even higher stresses, aerodynamic buffeting, cyclic loads.

In short, titanium has the properties needed to make the supersonic transport a practical reality!

More than 186,000 hours of flight, selection by three services, scores of speed records have swirled and twisted time vital systems operations: the subfloor, torque box, and inboard sections, and the tail cone, which thrives in the swirling embrace of the jet valve, the access doors that surround the tail pipes, and the 14-ribbed ribbed web on the tail beam, between the engines, plus many other titanium parts.

For more than a decade, McDonnell, which is noted for the thoroughness of its materials testing, has continued to use more and more titanium in its aircraft. The F4H/J-4C uses twice as much titanium as the F101, 10 times as much as the F1. In fact, he and of titanium that no other metal except aluminum has been so thoroughly tested and tried, proved in flight, and found so reliable.

A whole spectrum of fabrication and titanium mill products join into the making of a Phantom. Titanium Metals Corporation of America supplies much of the titanium, a network of fabricators spread across the U.S.A. supplies a multitude of skills. This capacity and technology is available now, today... to help solve tomorrow's Mach 3 problems.

Declining cost of titanium. In the decade since the Phantom first appeared on the drawing board, the price of titanium has dropped to less than a third. The trend should continue to grow as volume and know-how advance.

Write for titanium data sheet on the Phantom. Or for information on titanium applications... fabrication... fabricators... write Technical Service Department, Titanium Metals Corporation of America.

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titanium

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Stiffness, strength characterize the titanium underside of the aft fuselage section. Area is directly adjacent to jet blast. Despite heat shields, operating temperatures reach 700°F. Frame and skin material is 0.032" Ti-6Al-4V, longspan is 0.190" Ti-6Al-4V.



Hot forming is used extensively in producing parts for the aft-titanium tail cone. Frames are 0.032" titanium alloy (Ti-6Al-4V), skin is 0.012".

Resistance to fatigue and thermal stress, make titanium might choice for skin, ribs, and spars in key areas of subfloor. Torque box, with its 0.030" Ti-6Al-4V skin, must withstand cyclic loading plus aerodynamic buffeting, at temperatures of from 650 to 900°F.



WORLD  
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HELICOPTER COMPANY, INC.



Bell's leadership in research and development applies years-ahead thinking to determine future weapon helicopter design requirements. Bell's latest development is the new Sioux Scout, an armed-reconnaissance helicopter incorporating many new concepts. These Scout concepts are now undergoing intensive field evaluation.

A variation of Bell's famed OH-13, the turbocharged 207 Scout features tandem seating. The pilot rides high for excellent all 'round visibility. Gunner is placed low ahead of the pilot for control of the flexible Emerson chin turret mounting two 7.62 machine guns. Side-armed flight controls permit gunner to pilot the ship.

Stub wings contain fuel tanks, supply added lift for vertical flying and incorporate hard points for mounting special armament packages. Slant, unstreamlined fuselage means low drag, giving the Scout a speed and climb rate well above the standard OH-13.

At Bell, the Sioux Scout is only one of many advanced concepts under development... another reason why Bell is way ahead in rotary-wing research and development.



**BELL HELICOPTER COMPANY**  
FORT WORTH, TEXAS • A DIVISION OF BELL AIRCRAFT CORPORATION • A **TEXTRON** COMPANY

## A NEW CONCEPT FROM BELL THE SIOUX SCOUT

## BUSINESS FLYING



**NEW MODEL 204** Super Skywagon is specifically designed for short-range, light-weight transport and other specialized utility applications. The aircraft is a development of Cessna's earlier Model 205, high-density, air-prior personnel transport. Powered by a 205 hp, six-cylinder, det. fuel injection Continental IO-320-A engine, the Model 204 carries 1,380 lb., cruises 160 mph.

## Super Skywagon Broadens Cessna Market

By Erwin J. Bulawa

Expansion of Cessna Aircraft Co.'s utility aircraft line with addition of the new Super Skywagon leaves single-engine cargo model capable of pulling payloads of more than one-half ton, perhaps significant trends in the company's management thinking about future roles for business aircraft.

Indicators are that Cessna is rethinking on a scale that rivals a decade back with its previous estimate of the business aircraft market which have placed heavier emphasis on transportation of people. The emphasis has led the industry to concentrate its efforts more heavily, since World War II, on gliders, higher performance aircraft related to meet the transportation needs of business people.

The expansion of Cessna's cargo aircraft now is to stand back and take a whole new look at its business potential in light of what airplanes can do and what types of airplanes are needed to fulfill specific missions.

In steadily broadening its product line and thus diversifying its market, the company would also make itself less susceptible to the effects of temporary changes in any particular market, as it relies on increasing its overall aircraft business. Cessna has quietly entered a series of studies aimed at increasing

new marketing areas for airplanes and pointing up design requirements.

In this series of studies, one started approximately two years ago indicated increasing market possibilities opening up for the utility or "truck" type of aircraft.

Among the key factors pointing

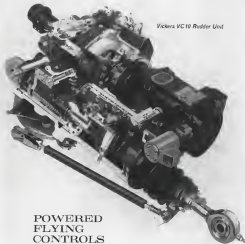
in this direction was a definite decline in the number of scheduled airline services between smaller cities and a continued decline in railroad service. Consequently there was a definite continued opening in dissemination of industry and building of local industry in these smaller cities, all leading to in-



**DOUBLE CARGO DOORS** on right side of the fuselage of Cessna's new Super Skywagon measure 42 in. wide, permit loading of crates more than 4 ft. long, 3 ft. wide and 3 ft. deep.







Vickers VC10 Raddler Unit

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of blade tilt from the 15-in. station from the hub to provide the blade with a greater outboard rotating moment, especially lowering the blade and shaft stresses and reducing the need for a heavier pinion that would be required to take these additional loads on the blades.

Model 218D Cushman also features new flaps and skids. Type of the flaps has been increased three feet outboard on each wing. To compensate for its increased span flap length without its causing wingtip drag, the skid has been telescoped and now its wide chord line type in place of the former planing simple trailing edge configuration. Where previous Model 216 skid was very counterbalanced design, the new skid now tapers, with reduced chord of about 15.5 in. and increased chord of about 11.5 in. Although the new skid cuts new line approximately one square foot less total area, the new design is said to provide noticeable improvement in control forces and maneuverability.

#### Tail Surfaces

Tail surfaces are also increased in size. The horizontal tail has been extended 4 in. on each side, providing an additional 2.4 sq. ft. of area.

Marked change in the interior includes use of leather trim of bucket design-electrically powered foot seats and an optional footrest along with provision for an optional convertible or fold-down console for storage of baggage and personal items.

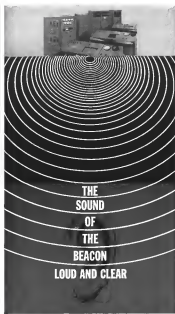
• Model 190 and 195 Skywagon utility airplanes for 1964 also show some changes over previous versions. The Model 190 fuselage and wings have been beefed up, with addition of structure to accommodate increases in the aircraft's gross weight, which is 2,900 lb. compared with 2,650 lb. for last year's 190. Empty weight is reduced 5 lb. and useful load is up 155 lb. from the 1963 model.

#### Heater Gear

The main landing gear is now the same as on the heavier Model 195 Skywagon, using a heavy duty spring and axle as standard equipment which was previously available only as optional equipment. Larger wheels and double-brake broken cones for the Model 195 and 205 and the Model 195's heavy-duty tail wheel and tubular spring gear assembly are also on the new Model 190. Interior has been rebuffed and an extra side window is provided for improved visibility.

New Model 196 lifts for \$16,818 from factory. Wichita

Model 195 Skywagon now has a main and tail wheel lock installed as standard equipment, an operating handle with a spring-loaded automatic device being



There's no more pleasing sound to the ear of a pilot than the steady "beep" of a beacon signal. It's his directional guidepost to a safe landing. Reliable, high performance communications equipment is a "beacon" in this regard of dependability that is the very design principle of ERCO Radio equipment. Whether the need be for VHF or UHF, high power or low power, the company has the design capability to meet every ground-to-air communication requirement. Should you have a communications design problem, place it in the capable hands of ERCO, whose many have found solutions, as well as savings in time and cost.

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## New heavy-duty printer for 8-level systems

Here is the new Teletype Model 15 printer. It offers a range of features that will bring new flexibility and improved efficiency to your communications and data handling systems.

- ☐ 11-level permutation code is compatible with many computers and data handling systems. It also provides extra code combinations for programming purposes.
- ☐ 4-row keyboard eliminates shifting for figures and common permutation marks. This saves key strokes, cuts errors, and makes every typist a potential operator.
- ☐ available automatic character generator can serve as a station identification device—or print out 50 characters of other repetitive data at the touch of a single key.

In addition, the Model 15 is equipped with the Teletype "stunt box," a versatile remote control

device. Optional features include a sprocket-feed platen for handling continuous business forms, vertical and horizontal tabulators, automatic feed-out for completed forms, and many others. Speed is 30 char/sec. Input is from local keyboard or line input.

The "15" is available as a send-receive printer (bi-directional) as a receive-only printer, or as an automatic send-receive unit with facilities for pushing and reading paper tape.

For additional information, contact Teletype Corporation, Dept. 22M, 3000 Tuskey Avenue, Skokie, Illinois.

*This type of equipment is made for the Bell System and others who require dependable communications at the lowest possible cost.*



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## FROM FAFNIR... BALL BEARINGS THAT HELP THE NEW XC-142A TAKE OFF STRAIGHT UP

The XC-142A—the first U.S. V/STOL aircraft scheduled for operational evaluation can take off straight up at 5500 to 7500 fpm. Fafnir Duplex Thrust Bearings in the propeller gear boxes help lift the plane's 20-ton-plus loaded weight.

Fafnir engineers applied advanced computer analysis in engineering these bearings for high capacity. SAE52100 consumable electrode vacuum melted steel assumes optimum reliability in the high-thrust bearing. The smaller flanged bearing is designed to absorb the lighter reverse-thrust loads. Both bearings are W1 counterbored type with low-friction, high strength, silver-plated iron silicon bronze retainers.

If extra-critical bearing applications pose problems for you, find out how the "computer approach" at Fafnir assures reliability. Remember: "Fafnir on your bearings means sound engineering, highest quality, full value at a fair price." The Fafnir Bearing Company, New Britain, Connecticut.



Fafnir Duplex Bearings take inboard gear thrust in each of the four subgear gear box assemblies of the XC-142A. Bearings are heat treated for dimensional stability at operating temperatures.

**FAFNIR**  
BALL BEARINGS



## HOW KEYS TO OUTER SPACE SECRETS WERE FOUND ON EARTH

When Eimac built its first vacuum power tube many years ago, we had no idea we were starting on a path that would lead us one day to outer space secrets. But we were. ■ A surprising number of materials that are now coming into prominence in aerospace hardware are well known at Eimac. For more than ten years we have kept a metallurgy laboratory busy dealing with the behavior of metals like titanium, tungsten, rhenium, osmium, and niobium, in a vacuum and at extreme temperatures. Eimac was the first to exploit the desirable electrical and physical properties of osmium for electron power tubes, and remains today their largest manufacturer. ■ At Eimac, the once black art of joining metals and ceramics has become a science. This experience makes it possible for Eimac to design aerospace structures that will retain their strength in such highly corrosive environments as liquid potassium, cesium, and even lithium. ■ Among Eimac's notable accomplishments in the aerospace field are the development of hermetically sealed ceramic-metal plugs which give ready plug-in access to thermocouples to read temperatures inside kilogrates (for rockets)... nuclear batteries... here used to include reactive elements in nuclear generators... sapphire-to-metal bonding of rf and optical windows. There are but a few of Eimac's new contributions to aerospace technology which have resulted from years of capability in vacuum tube manufacturing. ■ We recently successfully designed rugged new electro-explosive devices\* for rocket use. And we did it in less than four months. Reaction time quickly was possible only because we had the basic technology already at hand. Pin-to-ceramic and ceramic-to-body bonds are means of vacuum tube quality proved reliable in more than ten years' manufacturing history. These Eimac exploding bridge wire devices are now being flown on the new Pegasus A-3 developed by Lockheed Missile and Space Company, Sunnyvale, California, for the U.S. Navy. ■ In short, through long experience designing and building electron power tubes, Eimac has created links to new aerospace technologies, because we had to find out many answers that weren't generally available. We're taking these technological out of our pockets to help unlock more of the mysteries of outer space, helping to open the way to new aerospace developments.

1. We have a booklet covered with strong facts about our ceramic-metal technology. Write for it.
2. They're distinctive and specific. Want details? We'll be happy to send you more information.



located in the tunnel adjacent to the stationary bias wheel, replacing the previous electrically operated locking system.

Model 185 has for \$79,900 keyway history.

■ Model 182 and Skyline for 1964 feature styling changes at primary differences from last year's models. This includes redesign of the rear side window, extending three inches back, and reducing the width of the rear post. Also, the back window has had its outer post removed.

Interior window panoblation, electroplated front seats is optional equipment. A integrated switch and circuit breaker panel has smaller breakers with fast trip characteristics, new bracket positions being added for the audio amplifier and color lights.

The 1964 Model 182 is priced at \$15,425 and its Skyline de luxe version at \$17,875.

■ Model 205 airplane features are wheels and landing. Wheels are of shell-molded magnesium tube-type in place of disc-on-axle construction. New brakes, having higher leverage, are expected to provide comparatively double the life of previous design.

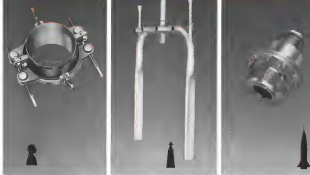
New gear center device has been designed to provide positive locking of the wheel with first application of the roller pedal to either left or right. New shroud dampers, consisting of a high-capacity barrel and larger diameter rod, are also installed for improved damping. Model 205 has for \$22,525 keyway history.

## Cessna Reports Sales Rise for Fiscal Year

Cessna Aircraft Co. reports sales of \$96,440,000 for its fiscal year ended Sept. 30, an increase of \$6,634,000 over the previous year. Revenue attributed to approximately 38,250 per share taking into account a non-recurring special charge in writing off the company's helicopter program and higher starting rates than anticipated in military programs.

Reported increase last year was in the Industrial Products Div., whose sales totaled \$14,711,000 as an increase of 87%. Commercial and parts sales were \$57,211,000, compared to \$14,376,000 in Fiscal 1962. Military sales, increasing the downturn of previous years, totaled \$15,128,000, an increase of \$949,000. Military backlog in Sept. 30 was \$12,530,000, more than double a year ago. Sales volume of Cessna's subsidiary, Aircraft Radio Corp., totaled \$9,188,000 in sales to customers other than Cessna. This represents a decline compared to previous year. However, sales to the parent firm brought ARCO's total to about the same as it was in 1962.

## FLUID SYSTEM ENGINEERING CAPABILITY IN ACTION:



### Recently Operated COMOSEAL® Joint Will Assure Leakproof Connections on HERVA Nuclear Engine Lines

Designed for remote operation of tubing in a nuclear reactor system, this special COMOSEAL joint maintains hermetic leakage performance through high-speed longitudinal (like standard style COMOSEAL joints). It employs an unique central metal probe to maintain a perfect seal through thermal cycling and pressure stresses. This is one of many joints utilizing the COMOSEAL principle engineered to special customer requirements by AEROQUIP, JACKSON, MICHIGAN AND BERKELEY, CALIFORNIA.

\*COMOSEAL is an Aeroquip trademark.

### New Transition Fanning Process Improves Weld Reliability on SNAP-10A Liquid Na-K Coolant System

Fabrication of an special 218 stainless steel tubing system with maximum weld reliability was accomplished by developing a new transition fanning process. This procedure assures precise joints, butt welding and 100% inspection of welds to insure integrity of the liquid sodium-potassium system used to cool the AEC's SNAP-10A space nuclear reactor. Special tube fanning and system fabrication is another of the fluid system capabilities of AEROQUIP, JACKSON, MICHIGAN AND BERKELEY, CALIFORNIA.

### LOX System Cryogenic Joints Set 4-Year Reliability Record on Ther Venach Pod 17A & B

Operating at temperatures as low as -208°F, the original bonding theory and cryogenic joint techniques at Pod 17A and B at Cape Canaveral are still in use after 4 years of continuous service. Only routine maintenance of these 47 cryogenic ball joints, involving similar replacement, has been required. Ball joints designed to meet a wide range of temperatures, pressure and fluid compatibility requirements are produced by AEROQUIP, JACKSON, MICHIGAN AND BERKELEY, CALIFORNIA.

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Aeroquip's exceptional capability can help you solve problems in meeting the fluid conveying requirements of the aerospace industry. Products developed include everything needed for port-to-port installation, and invariably achieve the "state of the art" in the fluid conveying field. A look-back program that involves thousands of man hours to advanced studies of tempera-

ture, pressure, new fluids and new materials, plus an already extensive product line, keeps Aeroquip ready to cope with even the most unusual requirements.

Look to Aeroquip first for assistance in fluid system engineering. Contact any of the Divisions mentioned above for complete information. AEROQUIP CORPORATION, JACKSON, MISS.





Could you put a 50 kw transmitter in this space?



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A Westinghouse Solid State Transmitter (Series ST) fits in about one tenth the space you need for conventional designs. It weighs only one third as much, requires far less cooling, operates with 80% efficiency. And it is 10 times more reliable on the basis of MTBF.

Series ST transmitters have made it possible to apply high power communications techniques (up to 100 kw) in many areas where tube type transmitters are impractical.

Using Westinghouse developed solid-state technology, such as transistorized environments, in ships, submarines, aircraft and land vehicles, can now support advanced high power communications systems.

Other applications include underground and underwater installations, where equipment must operate unattended for long periods.

Westinghouse Surface Division pro-

duces Series ST Solid State Transmitters in a variety of configurations for special-use defense communications systems. These highly versatile systems are built on a solid-on-of-how the broad capabilities of Westinghouse can answer your most urgent needs in electronics.

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We never forget how much you rely on Westinghouse



#### AiResearch YT76 Turbogrop Being Tested

Cesset Aerospace YT76 turbogrop engine will begin 50-hr. performance flight testing late this month, and the company hopes to have Federal Aviation Agency certification by the end of 1964. Engine is 100 hp turbogrop with power-to-weight ratio of 1.11 hp/lb. and specific fuel consumption of 60.4 lb./hp-hr. (AW Dec. 15, 1963, p. 76). YT76 has three-stage turbine with each stage made from one-piece ring and outside diameter increased to fit to one of the three stages. Turbine blades are cast (aluminum) with hub. YT76 is under consideration to power first Navy countermeasures aircraft projects (AW Nov. 11, p. 40) and is being studied by Pacific for observation as power prospect for that company's 101 F-4 Phantom II replacement (Herald Nov. 11). It is considering it for single and two-engine versions of its Helio-Cover, and Aero-Cover as a possible contender for the engine for a new business aircraft. Valpar, Inc., will develop YT76 on Beech Model 15.



## CP Motor capability



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**TITANIUM INGOTS ARE VIEWED** by an inspector (above, left) after going through a large vacuum furnace like that at right. To get the high purity desired, ingots are melted twice under vacuum. Now, too, for the world air-breathing propulsion and the industry expects second levels to be set in the next decade, even if a materials technology is not developed.

### *Titonius's Future—Part 2:*

## New Uses Increasing Titanium Production

Re Michael L. Yaffee

Aerospace industry, which now makes 91% of total titanium production, is expected to find numerous new applications that will continue to push consumption to record annual levels.

Producers forecast extensive use of titanium in bombers, fighters, transports, V-STOL, and spacekind aerospace vehicles that will be designed to operate at speeds and loading conditions demanding titanium's temperature, strength and structural capabilities.

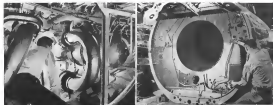
They also forecast a continuing growth in consumption of the metal for existing aerospace applications.

Total production of straw could jump dramatically if it were chosen for an important role in the proposed U.S. renewable transport program (AWD Dec. 3, p. 48), but with or without that program, producers are optimistic about the future.

Consumption now is between 13 and 14 million lb annually. In addition to the 90% going to aerospace uses, chemical and other industrial process applications account for 6% and the balance



DATE OF VARIOUS USES to which Division is put is in the horizontal column of the McQuay-Norris 48/5 AC. Titanium consumption now is 11.04 million lb. year.



**TITANIUM ACCOUNTS FOR 3%** of the weight of the Boeing 747 three-engine transport. One can (above, left) see the tubing for the heating system of the passenger cabin. Large bottle is 40-gal water reservoir tank, also of titanium. Forewell (above right) is another use of the metal. Total weight of titanium in aircraft is 80-lb, according to a survey of producers.

space field takes the remaining 1%

Within the next 10 years projected growth patterns, market researchers forecast a gradual price component increasing in relative position in the next 10 years, increasing progressively as much as 25% of the total titanium output. Also aerospace titanium usage is expected to increase on both an absolute and relative basis over the next decade. After five years of steady R&D studies, the titanium submarine program appears to be ready to move.

The estimated 91% of the present aerospace market credited to the aerospace industry breaks down as follows: 52% assigned to manned military aircraft, 31% to missiles and space vehicles and 17% to civilian aircraft. The overall forecast for these categories is optimistic.

Titanium applications in animal husbandry include the following:

genes and sequences. At last week's symposium, genes accounted for approximately 75% of the total genomes studied. The figure is now about 30% and will probably continue to drop slightly over the next few years.

The largest percent application to titanium is in turbofan engines, with the material accounting for as much as 20% of engine dry weight in some units. The jet jet is expected to play a significant role in both commercial and military aircraft programs for some time and, accordingly, will continue to be a major outlet for titanium alloy.

As jet engines start making boreds Mach 2, less and less of the exposed structure remains within transonic temperature capability. The jet engine Pratt & Whitney is making for the Mach 2 plus TFV fighter are expected to make the most extensive use of titanium to date—about 75%.

weight. This 25% probably will prove close to a maximum figure in capital-scarce environments. At the same time, percentage use of titanium is yet higher in the higher Mark II range is expected to continue increasing somewhat.

In addition, titanium usage has grown steadily since it was first used in the aft fuselage of the F-16 and is expected to continue to do so, both in new designs and in modifications of existing designs. Titanium and its alloys are being used in almost all types of structures and components, including skin panels, bulkheads, cover panels, rib stoppers, pylons, tie rods, cross members, beams, frames, longitudinal wing spars, fuselage, channel rails, wing ribs, extrusions, hatch doublers, stringer, bottles, and speed brake doors.

Interestingly enough, once it was assessed, in working its way into a national model program, the review indicates that the amount used generally keeps on growing as increasingly more advanced models.

The struts of the first B-52, for example, used 568 lb of titanium while the B-10G, produced six years later, contained 1,680 lb of titanium. Similarly, the DC-7 used 450 lb of titanium while the DC-7C contains 900 lb.

contractions for the hot-reflower structure. At the same time, North American structural engineers made two parallel developments: use of titanium alloys (Ti-6Al-4V, Ti-6Al-2Sn) where load with weight control and thermal gradient problems. The forward facing, for example, is a double-walled semi-monocoque structure in which transverse frames support an internal 8 meter dia and an outer

curtain cross skin. In the old building, a diagonal substructure supports an internal X primary structure. And to insure it used in the frame and ribs in the wing.

In North American countries, Nishikawa RS70, the primary structure material is 70-13 75Ni steel. The concept and safe research for this aircraft steel has only been in a time when high price, lack of fabrication experience and general lack of knowledge weighed heavily against use of titanium. Yet, 85% of the aircraft is now estimated to be titanium—including titanium skin-stringer sections in the fuselage and elsewhere, much of the substructure and many components.

Titanium is being used in only one major solid-propellant rocket system—the motor case of the Minuteman ICBM second stage—and the outlook for titanium applications in the solid motor case area is generally dim. As new solid-propellant rocket structural material candidates, there is some interest in glass filament wound, epoxy bonded composite material.

Moisture damage is, of course, an involved procedure influenced by such things as season profile, flight levels, stage loads, ground handling loads, environmental conditions, individual design cost and even the materials used. But in the case of large, solid propellant rocket cores, the two principal loading conditions which govern design are internal pressure and loads due to external loading.

External pressure, generated by burning of the solid propellant, creates short-time but high flexural tensile stresses which tend to produce failure in tension. In such cases, tensile strength becomes the important structural index and the ratio of ultimate tensile strength to density becomes the governing factor in motor case weight.

# 0825



## AUTOMATIC MESSAGE PROCESSOR FOR THE U.S. ARMY

The U. S. Army was looking for a solution to a communications problem, and found it in the Burroughs Multiround DMS Modular Data Processing System. With its totally modular concept, the DMS accommodated several special modules. The resulting modular design became a communications switching system.

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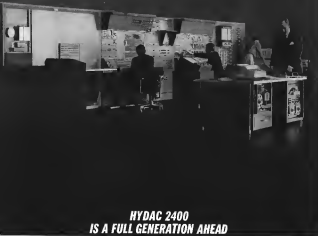
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most loading feature of the riveted cylindrical shells may be produced by bending moments or, more likely, by axial compressive loading or by a combination of the two types of loading. Here, elastic instability becomes the important structural characteristic and the size of the elastic part of the effect two elastic motions to the south because the governing factor is elastic instability. (In both cases, the higher the ratio, the lower the weight.)

On assignment from the Office of the Director of Defense Research and Engineering, the Defense Metals Investigation Center at Battelle Memorial Institute carried out a detailed study of the design considerations affecting the selection of materials for legs and supporting member under cases (DMIC Report 158) which is now in the process of being updated. In this report, based on the foregoing structural analysis and certain assumptions, the authors concluded:

- For monolithic construction (including bentonite), the titanium alloy tends to be the lightest material, except in very high external loadings where aluminum alloys look promising. In all instances, steel makes sense only when titanium alloy cases or a weight volume basis.

- For any combination of loads, there is a composite structure which is lighter than the lightest monolithic structure. However, there is no single type of composite structure which is best for all ranges of external loads.

- For relatively low external loads representative of ballistic missile applications, a glass filament-wound, resin-loaded composite results in the lightest material cost per enclosed volume.

- For the intermediate load range associated with boosters for extended vehicles and some stages of earth-orbit launchers, the composite of glass filament wound resin bonded to an aluminum alloy base gives the lightest material cost.

- For the very high loads associated with the intermediate stages of an earth-orbit booster, the sandwich type composite of glass filament wound and an aluminum alloy laminate core appears to be the most promising from a weight-volume standpoint.

Commenting on this report, Battelle's Walter S. Hyler, one of the authors, points out that one of the assumptions made was that only room temperature properties were to be used. Because actual motor cases will be loaded by friction as by propellant burning, however, Hyler says there is a good possibility of a temperature rise. And a temperature rise would reduce the properties of the glass filament-wound composite more than that of titanium. But just how much better titanium would look at elevated temperatures is

## PROBLEMATICAL RECREATIONS 200



Find these insights in *LeisureTime* magazine where product is prime.

—Continued

Monroe Calculating Machine Company, Monroe/Swede Cash Register, and Cole Steel Equipment Company—three divisions of our Business Machines Group—are eagerly waiting completion of their new facility in Des Plaines, Illinois. We're happy for them. They need the room. Their new, 35,000 square foot building, now under construction, will provide expanded facilities for the Group in the metropolitan Chicago area.

ANSWER TO LAST WEEK'S PROBLEM: Any number with two different digits, having the sum of its digits less than 10 will produce a palindrome number in one operation. We need consider therefore only numbers the sum of whose digits is 10 or greater. If the sum of the digits is 10, 11, 12, 13, 14, 15 or 16, the number of operations required will be 2, 3, 2, 2, 3, 4, 6 respectively. Only when the sum of the digits is 17 are more than 10 operations required. But the only number having 17 as the sum of its digits is 89 (or its reversal, 98).

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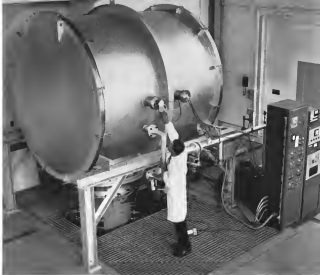
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comparison to the filament wound composite would require more data and evaluation at the different temperatures in question.

Dr. George Girard, structural engineer-in-charge at New York University and now vice president of Allied Aerospace Associates, agrees that in solid-propellant motor cases today and in the foreseeable future, with their high internal pressures causing stresses and strains, the governing design criteria, filament wound composite appear to be the strongest structural candidate and have much structural potential.

#### Metal Cases

On the other hand, says Dr. Girard, in very large solid-rocket motor cases where compressive buckling considerations may become critical and the role of the space ribs of the case tends to be design because the governing design considerations, the picture may change and metal cases might look better than filament wound composite cases.

Outlook for titanium in large liquid-propellant rocket is mixed. In large liquid-propellant rockets, titanium alloys have been the structural materials of choice for the afterside because of low joint weight, and relatively low shell loadings.

Except for the Atlas ICBM, in which the primary structure is a non-supporting, thin-walled shell made out of steel and governed by tensile strength/density design considerations, large liquid rockets are designed on the basis of buckling or crippling strength to density ratio.

Based on these considerations, titanium appears to be the most efficient structural material. Accordingly, the aftersides of large liquid-propellant rockets such as the Titan, Titan and Saturn are for the most part being made of titanium alloys, employing in many cases conventional design/weight considerations.

#### Potential Limited

At the same time, titanium appears to be gaining a foothold in smaller liquid-propellant tanks. Presently, for example, T-6A1-IV is being used for the oxidizer and fuel tanks in the Titan 3 booster; and for the Apollo service module and the Lunar Excursion Module. Its overall potential in this area is somewhat limited by its rapid weight increase in the presence of liquid oxygen.

The potential use of titanium in space is not clear. In most cases, weights and engineers know what the critical loading indices are for launch vehicles and missiles but don't yet know what they will be for space vehicles.

Allied Research, for example, is cur-



TITANIUM MEMBERS TYPICAL of components used in McDonnell Douglas F-4C include afterside element held by welds. Similar units would go into space launch system.

rently studying, under contract from NASA, the structural suitability of design and materials in relation to space vehicles. One of the parameters studied, it is hoped will come some indication of when structural considerations are important and when weight considerations are expected to be most efficient in space vehicle design.

At the point, says Dr. Girard, it is not known whether titanium or composite considerations or factors other than loading will govern space vehicle design. If it is even conceivable, he points out, that other factors such as erosion or penetration or plasticity, loading conditions might point to be governing reasons for the major structural components.

The first volume use of titanium alloys in extremely large space structures has been in the proposed Project Mercury capsule. Mercury's strange end-loading, under skin, forming its antenna and parachute, and other systems are built mostly of titanium. Each of the structural components contains 45,000 in. of welds and is designed to

withstand loadings up to 20g. During re-entry, titanium straps (spacecraft) reached 600F (over-100 reached 180F).

McDonnell Aircraft Corp. is making extensive use of titanium alloys in the Gemini capsule, where there is a 10-ton alloy T-6A1-2.55. The members of the pressurized crew compartment are made by welding together two sheets of non-corrosive pure titanium. Landing gear struts are fabricated from Ti-6Al-4V alloys. Adapter rings and nozzle inner-connections are made from Ti-6Al-4V, and recovery buffers are constructed of Ti-6Al-2.55 and Ti-6Al-4V titanium alloys.

#### Mer is Apollo

Even with its successful performance in the Mercury capsule and its receipt of the Gemini capsule, titanium failed in its initial bid for structural applications in the Apollo spacecraft. North American Aviation decided not to use titanium in either the crew compartment or in the service module but to go with aluminum and steel (AW, July 22, p. 124). Now, however, it ap-



## FORGING SATURN'S MIGHTY MUSCLES

When the nation's space program relies completely on a single launch vehicle—as on Saturn V—dragsters, coasters and the National Aeronautics and Space Administration also demand more absolute levels of component reliability. Wynne-Gordon's participation in Go-Go, such a variety of airborne, structural, and propulsion parts for the Saturn program is more logical. Here is entered the industry's broadest aerospace firing expertise—also an outstanding construction of

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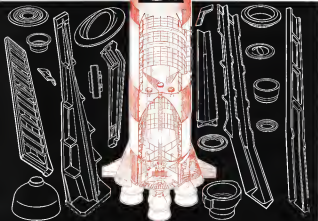
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### Titanium Welding Chamber

For glass parts present a risk to weld titanium, made a vacuum chamber while shielding outside. Chamber, built by the Herring Corp. of Van Nuys, Calif. for Lockheed California Co., is 6 ft. long, 42 in. in diameter and weighs 2,500 lb. It has eight safety glass viewing windows through which workers can observe welding operation. Chamber is made of aluminum alloy. It permits welding at sustained high altitudes, because titanium requires a high, dry atmosphere during welding.

years that some programs will be used in the service ready to be added to the fuel and oxygen loop.

Outside of aircraft interiors, the most promising aerospace application for piezoelectricity appears to be a pressure bottle designed to hold cryogenic and other fluids needed in aerospace systems.

(total) in the four helium storage containers in the X-15, and 129 lb. in each of the helium pressure bottles used in the Atlas.

Of the many recent and current developments in fibrous technology, most of those of interest to the aerospace industry have to do with the development of new fibers and fibrous technologies.

## Gender and Allergy

At present, serotype characterization is primarily interested in the following codes and *dhps* of interest:

- Commercially pure titanium, common steel and with excellent corrosion resistance is used principally in non structural applications such as fasteners.
- Ti-5Al-2.5Fe, an alloy, readily available alpha alloy possessing good low temperature and moderate high temperature properties with good weldability.

### Weight Savings

Thermos pressure bottles designed for various applications reportedly have affected significant weight savings over comparable steel and aluminum containers. Specific examples given by Fluorocor Metals include 60 lb (total) vs. Alderson metal canister's three helium containers, 150 lb (total) vs. four helium bottles used in Titan 1, 5 lb. each for the three to five helium pressure bottles used in the Aerosol A ventricle, 525 lb.

- Ti-6Al-4V, an  $\alpha/\beta$  alloy (it refers to its crystal structure) with good high temperature strength, hydrogen resistance, weldability and low temperature notch ductility. It is one of the alloys and Ti-5Al-2.5Fe were the most widely used titanium alloys due to their extensive use in jet engine components.
- Ti-3Al-1Fe-1V, one of the newer alloys developed for high strength and creep resistance at elevated temperatures. It is of interest as the candidate



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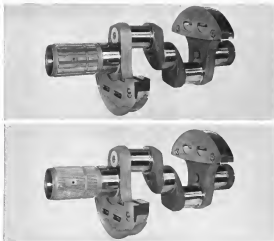
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## Military Version of Avro 748 Undergoes Resonance Tests

First photo of British Siddeley (Avro) twin turbojet 748NF, the military version of the 748 civil transport, shows the aircraft undergoing resonance tests at Woodhead airfield, near Manchester, England. The airplane features nose-down landing and variable landing gear for horizontal and vertical adjustment of four heights (AW Feb. 25, 1962, p. 35). Prototype, which will fly late this year, will be used to establish aerodynamics and handling qualities. About 50 have been ordered by Royal Air Force.

## WHO'S WHERE

(Continued from page 111)

**William F. Eddolls**, assistant director, Spacecraft Engineering Subdivision, Aerospace Corp.'s El Segundo (Calif.) Technical Operations.

**Edward R. McCann**, manager of military marketing, LTV Commercial Electronics Div., Long Beach-Vought, Inc., Dallas, Tex.

**Col. Ray E. Seay**, Assistant for Staff Support, Ballistic Systems Div., Norton AFB, San Bernardino, Calif., succeeding Col. Jack H. Miller, now in command of the Vietnam Contract Management Review, MacLean, Calif.

**Charles H. Hagen**, assistant administrator for operations, Federal Aviation Agency, Washington, D.C., succeeding Dr. Alexander M. Hagen, now in command of the FAA's Office of Safety. David M. Mearns succeeds Mr. Alexander as deputy director, Office of Safety.

**Richard E. Fies**, Jr., director, Technical Liaison Office, Massachusetts Institute of Technology, Cambridge, Mass.

**George Munn**, sales manager, Federal Control Div., Lockheed Electronics Co., a division of Lockheed Aircraft Corp., Los Angeles, Calif.

**Paul D. Wiley**, chief engineer, Electric Structures Corp., Tacoma, Calif., and Robert F. Morley, manager of quality control.

**Dr. Karl Ueberlein**, manager for corporate sponsored research and development, Engineering Div., General Dynamics/Perkins.

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## TFX Comment

In the latest column of your Nov. 18, 1955 issue (p. 171), reader Thomas Chisholm made a professional plea for a column to be "tailored" to appeal to the TFX. The pendant stem from the fact that Mr. Chisholm had just finished reviewing several old McChesno-sponsored letters that have been advanced for some time. For example:

1. The Pentagon heads are not selecting the plane that is superior.
2. The United States is getting a second-rate plane.
3. The word of the contract to General Dynamics was patently inspired to help the Democrats.

In the context of being really serious let's look again at some of the facts that helped explode each of these myths.

1. In the official scoring of the Military Service Selection Board the G11 proposal was rated higher than that of Boeing. (The Military Service Selection Board Rating. This old phenomenon would seem worthy of a full investigation.)

2. New weapons systems are not brought into existence or modified as they are developed. After months of design, research, discovery and testing by contractors and government teams, different weapon systems are proving to be better than concepts in original proposals of the competing group.

3. Secretary McNamara, who made the actual decision on the TFX award, is a Republican.

FR. MICHAEL LARSEN

## ALPA vs. CAB (Cont.)

The statements of D. W. Robinson under ALPA vs. CAB (AW Nov. 11, p. 138) appear to have been dictated by emotion rather than reason. His facts are, in many times, interesting; however, the fact that you had been applied, ration effort, as well as in the past, is a fact. (I am not sure if you have the right fact for at least 2 years after the reaction time had elapsed.) The other letter did not except Robinson to the board, which was not correct with Mr. Robinson that there was late time or margin for error. Furthermore, considerations are appended to the report which deal at least with some of the factors mentioned by Mr. Robinson. While it is true that the pilot of the first solo could have been killed, but not a trip, that is not really, except that "there is no margin for error" when the aircraft is on the ground, not low in the air. The pilot was not already accepted "solo" pilot, copies, first pilot error and what else is the person, that something can be done about.

Apart from the risk rate, do not parallel deal with the CFA accident at Honolulu, where an accident was attributed from a portion too low and close to present you into the first engine? Rather than keep in the infidelity of "The Aloha Pilot," should we not acknowledge that area of judgment do occur and try to eliminate them as we try to eliminate other threats

*Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 P. Third St., New York 26, N. Y. Try to keep letters under 200 words and give a genuine identification. We will not print anonymous letters, but names of authors will be withheld on request.*

to fight safety in the technical sphere? Negating this risk in the matter of having to protect a future pilot from emergency does not come to grips with the issue either, but as long as we hold that the safety of passengers and aircraft crew is directly with the pilot in command, this responsibility cannot be divided after the event. Neither, I dare to say, would the best work to see it shared.

S. H. J. HEN  
David, Quebec

Along the lines of the letter from Mr. D. W. Robinson (AW Nov. 11, p. 135), I would like to add the following comments. The FAA has just put up a new group of approach minimums (and related) using Keweenaw Visual Range (SVS) as a single limit. (Airspeed is changed by shortening the VMM required.)

As far as I can see the SVS system for rating approach is identical to one you will find a doctor setting a patient by a going to improve stomach error by holding a photograph's light meter over the man's stomach.

Any more progress made along these lines by the FAA will be when the towers will have a standard phrase, "RVN now 120 ft, cleared for takeoff" (or so, as the case may be). "We will notify your seat of it."

I know it is going to help the subject to be able to complete some accident but I can't see the method doing it by changing the rules.

I am employed by an airline (since July, 1959), have flown cockpit on everything from DC-10 to Boeing 707 and systems on DC-10 and CV-580.

ANTHONY PAUL  
Gardens, Pa.

## McNamara Critic

A word has escaped at Secretary of Defense McNamara's statement which disturbs me. It is contained in a list made at vulnerable to technical considerations more dramatic than the ability of Secret McNamara to attack us over the South Pole instead of the North, where everyone expects them.

The following points are correct in detail as I now remember them and may be of use:

1. The SS 70 rejection "It would require a role looking role" or implies that it may be beyond our technical abilities." McNamara.
2. The Skolobon conclusion "It is doubtful that the system can ever be made to work. There are no more operational requirements" John F. Kennedy.
3. The refusal to allow Nike Zeus pro-

jection "The missile could deliver nuclear warheads, but the problem of its staying a large number of warheads and down it and will probably remain, but not on technical ability." McNamara.

6. The C-140: "A state of the art design" suitable for an absence of human flow control or any other hard design factors. "A Boeing truck."

7. The TFX decision: "There is considerable doubt as to whether the technical advantages of the Boeing design would materialize in a production aircraft on schedule." McNamara. (Though, he is a change, he did not consider them beyond the technical abilities.)

8. The statement by Harold Brown that "We will continue to fund research programs as in the past, but from now on we expect to find only solidly proven development projects."

9. The claim of a conservatively proven operation over a nuclear powered ship ending only 1976 date.

10. The total absence of any major armed forces program undertaken since McNamara had based totally on data of the air construction. In this year this is a surprising record.

11. The doubt to the Air Force of any major role in space on the ground that "We consider programs for the use of space vehicles to one which we have been advanced." Had the decision of what was a feasible technical proposal been made by someone with a background in research and development work instead of not accounting it, at least, would not later.

Certainly it is a desirable thing to have armed forces supplied with specific reliable weapons, of all which work. But it was the Air Force which finally ended World War II, not the Air.

FRANK C. NORTON  
New York, N. Y.

## Maya Airways

Being very keen on checking up on my reading of AWST, I was very surprised to find that the Maya Airways is the October 14 issue ("Aviation Week" column, p. 16) to be made for Maya Airways.

I feel it necessary to bring to your attention that Maya Airways is not a member of the Republic of Honduras but owned a company registered under the laws of Honduras with personnel from the country of Honduras. We have nothing but the good, old money and nothing of good will for our employees.

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A statement is a subsequent issue of AWST would be possible to see more of the Maya Airways, President Maya Airways, Boston, Honduras.



24-Channel Communication Terminal Ready 8 hours after 'Touchdown'

After D-CA Standard—Collins new AN/TRC-90B is the first off-the-shelf 24-channel communication system to meet Defense Communications Agency needs. (Manufactured in quality in a single 5-1/2 ft. type cabinet. By adding another cabinet, power output may be stepped up to 10 kw with increased channel capacity.)

Lightweight, more compact—The AN/TRC-90B is the lightest, most compact

24-channel transceiver, transmitter or receiver available. Exclusive of antennas, the entire unit contained 1 kw communications terminal is housed in a single 5-1/2 ft. type cabinet. By adding another cabinet, power output may be stepped up to 10 kw with increased channel capacity.

Mobile, easy to move—Designed to be carried by aircraft or truck, Collins AN/TRC-90B is the lightest, most compact 24-channel transceiver in its class. It can be moved by a crew of six and is operable within eight hours after arrival in the field—ready

to provide communications virtually continuous on man-made and weather interference. In tactical situations calling for a signal of 100 miles, terminals may be placed on the air in just one hour by using 10-foot antennas instead of 25-foot antennas.

Field proven—Earlier AN/TRC-90 models are in use in the Far East and are serving Great Britain in its current operations. If you want to find out what the latest in transceiver communications systems can do for you, call Collins.

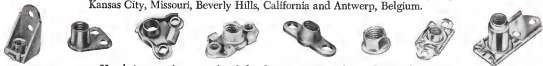


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